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MAY - 350 Monthly

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Engine

can bring quiet mowers, outboards, home generators

PAGE 110

LET'S
ABOLISH STUPID
SPEED LIMITS! PAGE 65

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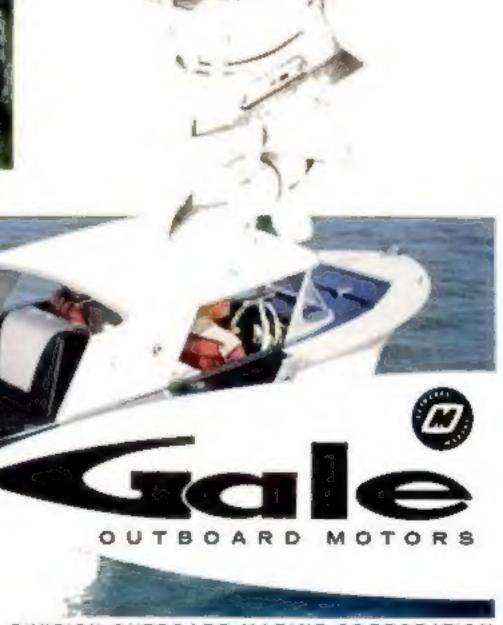
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Speed Laws: Are they as silly as they seem? P. 65

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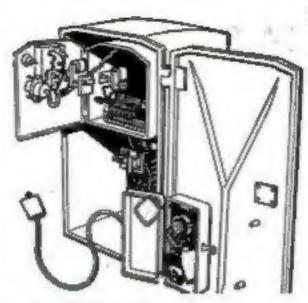
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PS Readers

TALK BACK



Mail Call in All Languages

THE article on oil burners ["Smaller, Hotter, Cheaper," Nov.] proved that PS certainly gets around. I have received more than 5,000 letters from North and South America, Canada, Europe, and faroff Japan.

I feel deeply for the many who wrote from Alaska. One man mentioned using over 400 gallons of fuel oil a month. At 30 cents a gallon that must present quite a problem.

> WILLIAM J. WALLER Waller Research Beacon Falls, Conn.

Bounding the Universe

I ENJOYED reading about the 600-foot 'scope ["New Radio Telescope Is Man's Biggest Machine," Dec.], but must take exception to one point you make: that it will help settle the controversy on the beginning of the universe by determining if there is matter beyond six billion light years.

While the radio 'scope will be able to
"see" much farther than that, at this
time it is impossible to determine the
distance of any radio source except when
it is clearly identified with optically visible phenomenon at a known distance
from the earth. Unless a method for doing this is discovered, it will be impossible in most cases to distinguish between
a relatively close weak source and a very
distant strong source.

M. M. RUBENSTEIN, Cleveland.

This has been a problem in optical astronomy for centuries. Only the closest stars can be located by surveying methods because the longest base line we have fits inside the earth's orbit—short by astronomical standards. Farther stars are gauged by estimating their brightness, and by measuring their "red shift" (the

Doppler-effect change in the wave length of their light, caused by their movement away from earth). Radio astronomers are trying the same tricks to pin down distance.

Can You Beat This?

I'm A lover of good cars and read all about the different kinds in PS. I'd like to tell you about my 1950 Dodge. There's 104,000 miles on the motor and I have never removed the head. How come more cars aren't built like this?

WARREN BOND, Mountain, W. Va.

Praise for Old-Timer's Way

I HAVE been trying the Old-Timer's method of wood finishing [Nov.] on white pine, white and red cedar, and butternut. I'm vastly pleased with results.

I used wood ashes (incidentally, hardwood ashes are greatly superior to softwood). When my supply ran out, I found that Gillett's lye filled the bill. This is



pretty powerful stuff and only a little should be added to plenty of water. It's best to experiment on scrap wood until you find the strength for desired results.

F. G. SEMPLE, Ottawa, Can.

Building a Magnetic Motor?

My Model engine ["Magnetic Motor Looks Like a Steam Engine," Feb.] is somewhat marginal in its operation on AC—unless specifically designed for it. On DC, it is much more powerful, smoother, and cooler running (the power losses show up in the form of heat).

So I've hooked up my motor with a fullwave bridge rectifier (no choke smoothing necessary) and dispensed with the condenser. Half-wave rectifiers aren't sat-

POPULAR SCIENCE MAY 1960

CONTINUED

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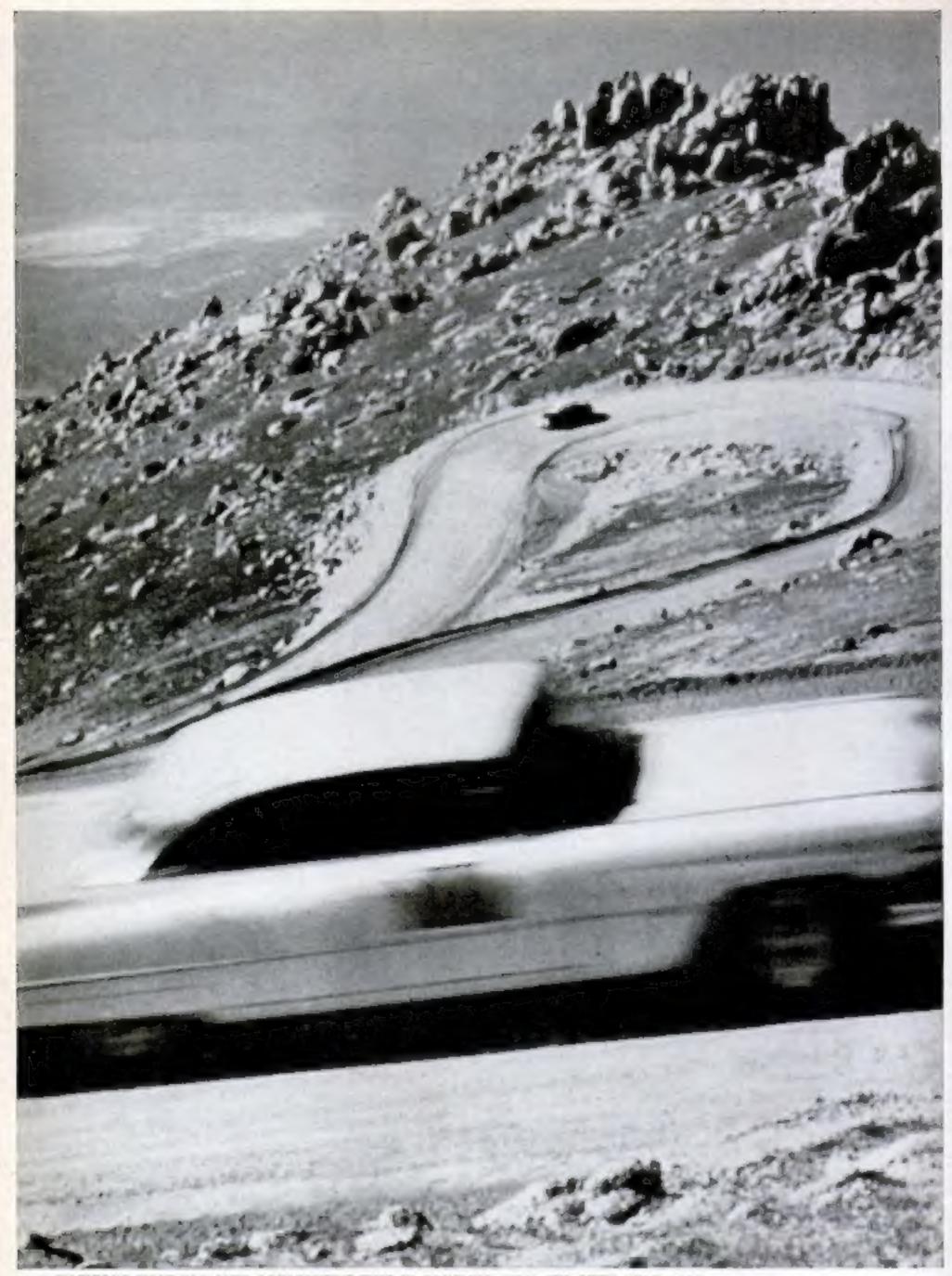
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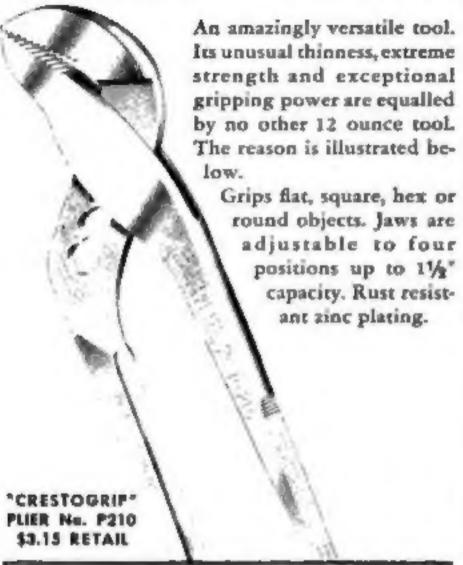


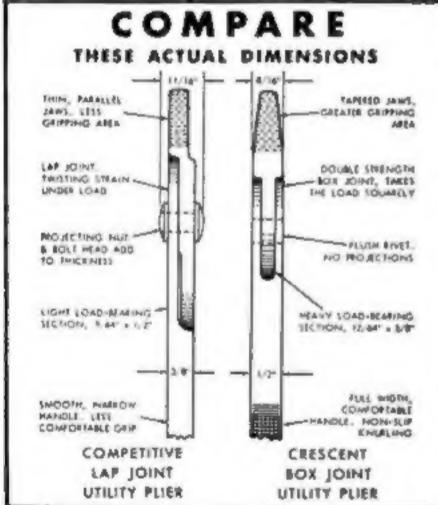
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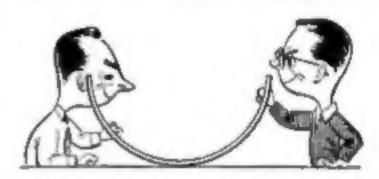
isfactory and full-wave bridge rectifiers are hard to find. I have a few and any interested reader can have one for \$3, plus 25 cents for mailing. These are surplus (new) and actually worth quite a bit more.

JAMES MCKINNEY, Englewood, N. J.

Catching Up on Laws of Nature

I ENJOYED "Camera Catches Laws of Nature" [Feb.], but question the presentation of one of the laws. I don't think two bullets, one dropped as the other is fired from a gun, will hit the ground at the same time. This would be true only if the earth were flat. The farther the fired bullet travels, the more the earth's surface drops away from it, requiring it to fall a greater distance. Consequently, the fired bullet would hit after the dropped one.

On the pendulum law I have a question for you: Instead of a pendulum, imagine a trough—a semicircle with the open end up. Take two steel balls and place one on



each side but in different positions, I contend that they will always meet at the center of the trough, regardless of their respective starting positions. Am I correct? My friends don't agree.

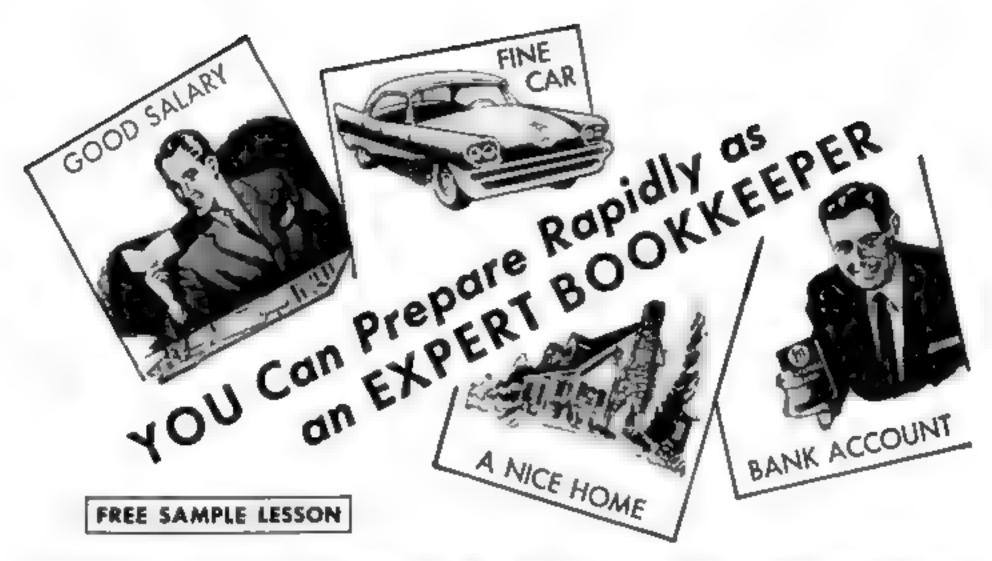
J. M. KARL, New Brunswick, N. J.

Right on both counts. In the case of the rifle bullet, it doesn't ordinarily go far enough for the earth's curvature to make any difference—the earth can be considered flat. But if the bullet is shot fast enough (space-rocket speed) it never falls back to earth.

physics course you make this statement:
"The fact that energy cannot be destroyed (or created) is one of the few absolute positive laws of science—no exceptions ever."

No such statement was made when I took the course last year in high school. The concept of interchangeability of matter and energy marked the beginning of the Atomic Age with Einstein's equation:

CONTINUED



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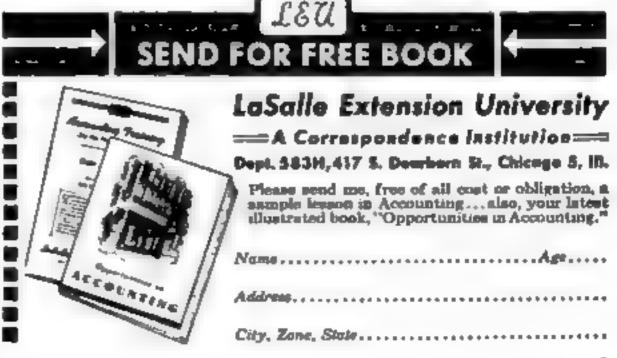
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energy created equals mass destroyed times the speed of light squared. This results in an enormous energy potential. One gram of any kind of matter, if completely destroyed, will create 25 million kilowatt-hours of electricity. On the other hand, matter can be created by paraproduction, as has been observed by cyclotrons (25 million kilowatt-hours to create one gram of matter). Thus, energy can be created from or changed into matter.

CARL SMITH, White Bear Lake, Minn.

. . . I MUST disagree with one of your statements on the laws of science. Energy can be created. Approximately one gram of matter was changed into energy in the atomic bomb.

George F. Pickett, Atlanta, Ga.

Our statement is absolutely true, Energy can be converted into matter, but that is not at all the same as destroying it. Fundamentally, energy and matter are just two aspects of the same thing, For convenience, we sometimes call this "one thing" energy, sometimes matter.

Curiosity Cost Him

HI-FI speaker had been getting progressively better over the years. Couldn't understand it. Dogs sniffing round same aroused suspicion. Opened enclosure Found myriada of mouse nests on cone. Removed same. Speaker now awful. Need



help-how does one go about weaving mouse nests?

Incidentally, are these what are known as konzert-mice-ters?

JONAS ARNOLD, Wilton, Conn.

What is a Rose Engine?

Your nomenclature is in error in "How to Build a Rose Engine" [Dec.]. The device you show is a modification of the geometric pen invented by Count Suardi in the 18th Century. The rose engine is a lathe having means to move the headstock both longitudinally and crosswise

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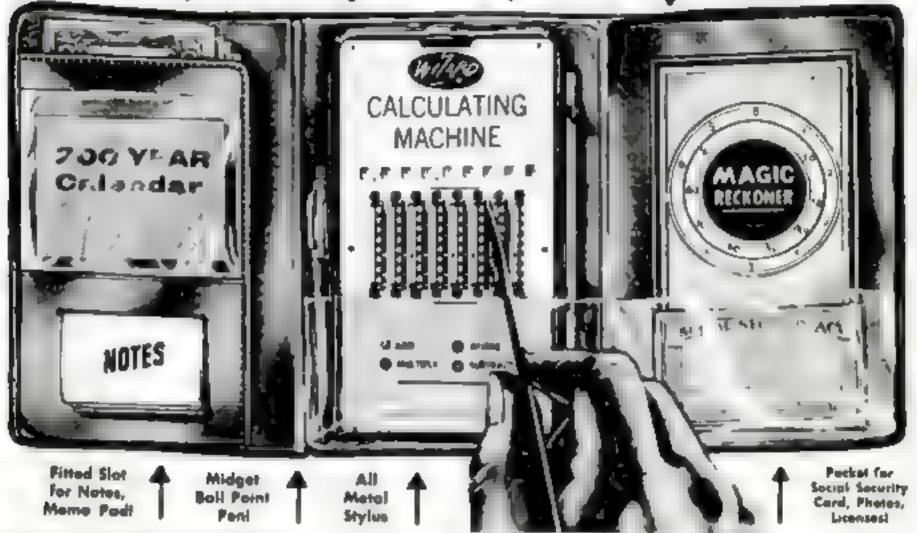
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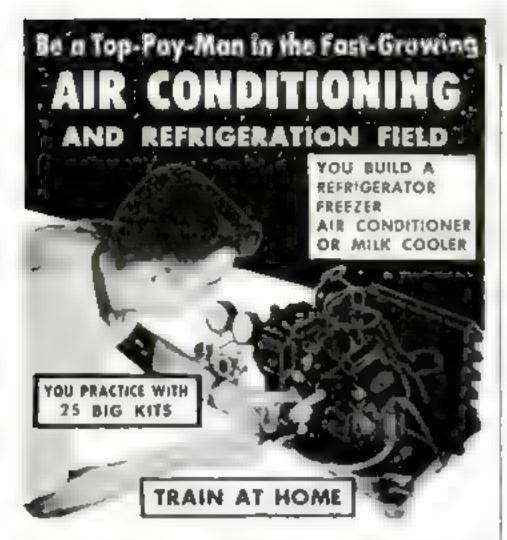
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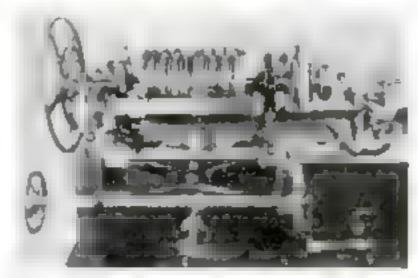
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of the bed; its work is three-dimensional. Engine turning was the special pride of 17th and 18th Century turners and the hobby of Victorian nobility.



The photo, from my collection, shows a rose engine built by Holtzapffel and Company in London before 1838. The



drawing is from a book by Suardi in my possession, printed in 1752. He calculated that this geometric pen could produce 1,273 different figures.

W. G. OGDEN JR. N. Andover, Mass.

Reader Ogden's scholarly objection is undoubtedly correct; Webster defines the geometric pen as an instrument for drawing curves. Other dictionary entries becloud the issue by stating that a rose engine is a machine that "forms on the work a variety of curved lines, as on paper currency," and by defining a geometric lathe as "an instrument for engraving bank notes."

Acceleration and the Falcon

In your report on 10,000 miles in a Falcon [Feb.], you say "it weighs just about what the old Model A did, and accelerates much like it." Then you say the Falcon has more than twice the horse-

Now, a horsepower is lifting a given weight a given distance in a given time (overcoming inertia is the same as lifting



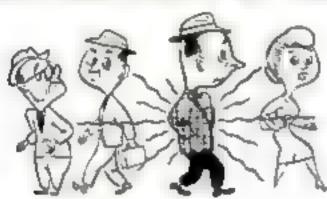
weight). Why doesn't the Falcon accelerate twice as fast?

MAURICE ROBERTSON, Ronan, Mont.

The old Model A peaked at about 2,800 r.p.m.—it began developing its push early. You have to wind up the Falcon to 4,200 before it reaches its max. Box and axle ratios also determine acceleration.

A Clean Male Aura

THE letter writer who commented on Smell-O-Vision movies [Feb.] might be



awed to know that there's a new wonder on the way: scented polyethylene.

Any day now, his laundry will be coming home poly-wrapped with a "cleanlinen" aroma, and his next sport jacket may be sealed in plastic that gives it the aura of pine. All this allure, put out by the Fragrance Process Co., is called Poly-Scent

J. P. McNamara, NYC.

lodine for Broken Screws

I have used iodine in place of a penetrating oil "When a Screw Breaks in Its Hole" [Jan.], or even before trying to remove a rusted or corroded screw. I squirt it at the base, then allow time for it to penetrate around the threads.

I've found this to be very helpful on screws used in cast iron or steel, such as head bolts or studs on engines. But iodine is no help in removing screws threaded into aluminum or pot metal

> CAROL BENGTSON Neb. Voc. Tech. School Milford, Neb.

The Workshop Whodunit

"THE Case of the Threading Cut" [Feb., p. 146] still puzzles me. The lathe operator was proved a liar because he said he'd been cutting an odd-numbered screw thread when the lathe was switched off, yet the policeman was able to turn

CONTINUED



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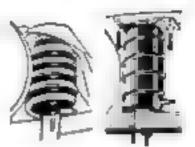


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the threading dial. The lathe operator could have been using the half nut and, to come back on his thread, could have been reversing the lathe. That way, he did not have to use the dial indicator.

NORMAN LAFORTUNE, Dracut, Mass.

The operator would have had to use the half nut to cut any kind of thread at all. That it may have been disengaged would prove nothing. Unless reversing the lathe as you suggest, the reflex action is to disengage it any time you stop work.

The threading dial was neither missing nor jammed, since it could be turned with the finger. In this case, a mechanic would certainly not prefer reversing the lathe to using the indicator.

A Wrench Works, Too

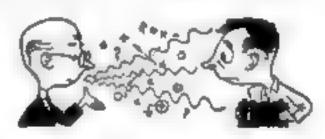
Tell, the guy who suggests opening a bottle by twisting a string around the cap and see-sawing the string back and forth ["Short Cuts and Tips," Jan.] to try a pair of pliers. It's easier and faster.

STEVE POPPE, Highland Park, Ill.

Everything Clear Now?

Your story on the Edison battery [Dec.] was interesting but went astray on terminology.

The negative electrode of a storage or primary cell is not the cathode, Anode



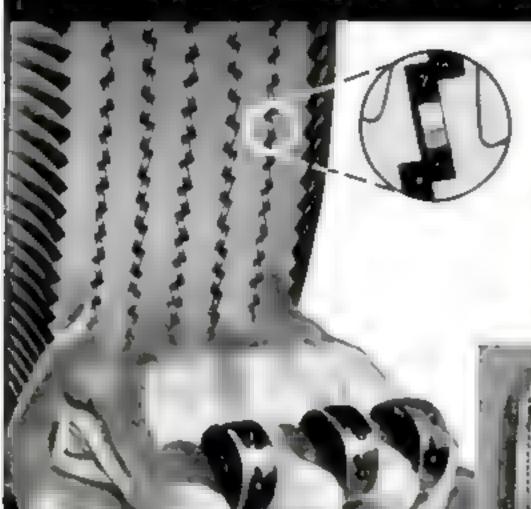
and cathode are terms associated with oxidation and reduction, respectively, and not with polarity. Since oxidation must occur within the cell at the negative electrode (the oxidation is what produces the electrons that make the electrode negative), this electrode is therefore an anode. At the other electrode, electrons enter the cell and bring about a reduction reaction (electrons are consumed). This electron is consequently the cathode but is given a positive sign (i.e. less negative than the anode where the electrons originated).

R. N. KELLER, Boulder, Colo.

He'll Stick To Tinted Glasses

I DISAGREE with the American Medical Association's findings that tinted glasses

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ONLY ARMSTRONG TIRES HAVE THIS PATENTED SAFETY DISC TREAD

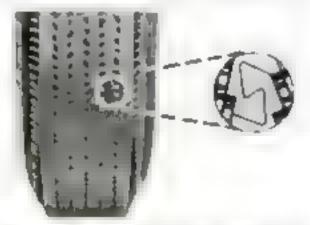
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are molded between the tread ribs of the Armstrong tire Just as the discs in hand at left keep the finters apart, so Safety Discs keep the tire's gripping edges apart. They can't squeeze smooth, no matter how hard you brake But the tread of ordinary tires lacking discs can squeeze together, go smooth and you stad!

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don't help in night driving ["Detroit

Report," Jan.].

One night last summer I encountered a great deal of oncoming traffic. Eventually the glaring tights made me drowsy I thought of stopping to rest, but first I tried wearing tinted glasses. My drowsiness disappeared and I drove another full hour in complete comfort.

EDWIN STARR, Malden, Mass.

Tinted glasses or windshields reduce the intensity of illumination (not glare) from oncoming headlights, and thus reduce light transmitted to the eye. This may make you feel more comfortable, but you are also cutting down your night vision, by seeing less light from your own headlights and the road lighting.

Colonials Got There First

I was amused to read about the desire of one of your readers for furniture locks to fasten sectionals together ["I'd Like to See Them Make," Jan.]. If he visits Williamsburg, Va., he'll find such locks on tables more than 100 years old, and copies on reproductions. Instead of the hinged plate you illustrate, they use a horseshoe- or hairpin-shaped piece. One leg slides into a slot on the underside of the abuttung table leaves.

C. L. Frederick, Chagrin Falls, Ohio.

Lubricating a Lock

THE drawings showing uses for pipe cleaners [Feb.] include one suggesting the use of a cleaner and light machine oil for lubricating a lock. Oil or grease should never be used in a tumbler lock as the small tumblers will stick to each

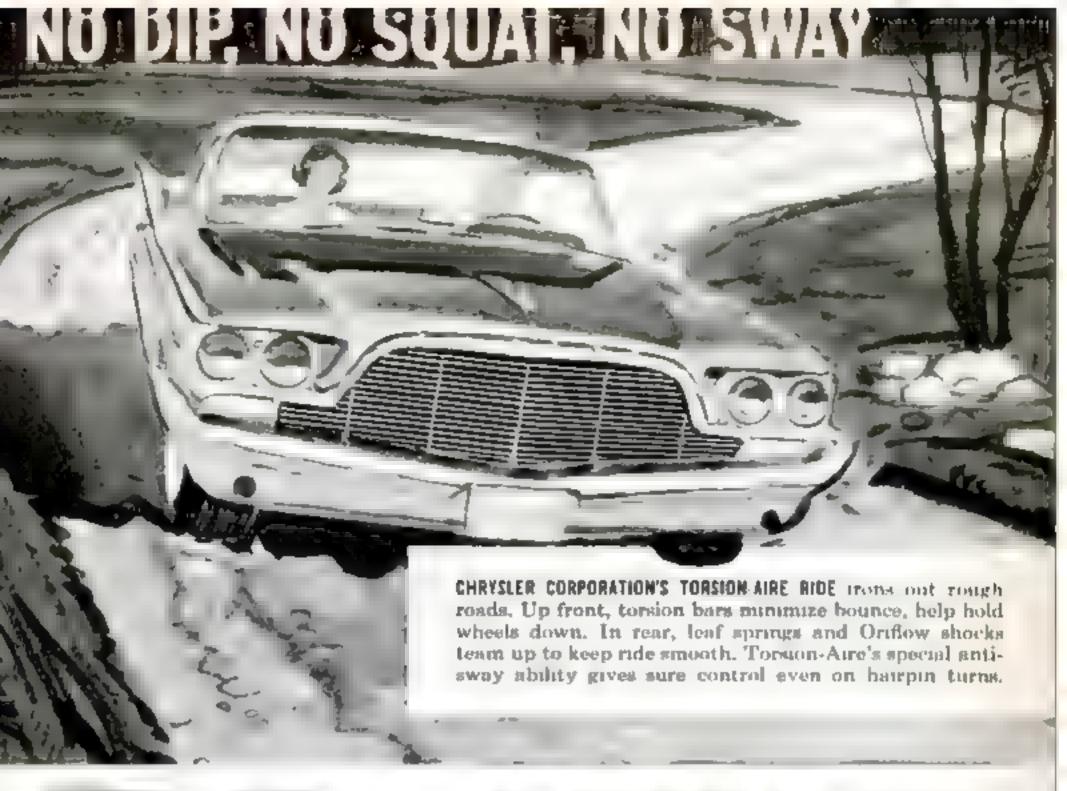


other and to the side walls. In maintenance work, we always use powdered graphite in a blow gun.

C. W. Evans Sr., Portville, N. Y.

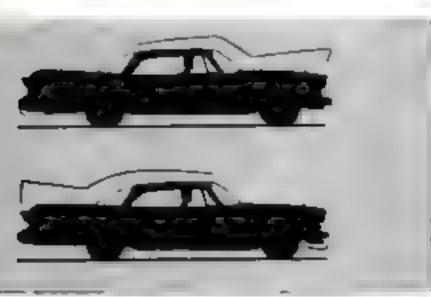
The Inexpert Archer

The torchlighter who used a bow and arrow to re-ignite excess fumes atop a natural-gas plant ["Picture News," Jan.]





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spare time – with a small table serving as your entire work shop.

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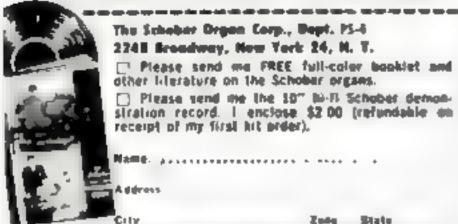
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amazed me. If the man pictured is an "expert archer," as you say, he shoots a bow a lot different than we do here in Minnesota. He has the arrow on the wrong side of the bow, the arrow is not on the



arrow rest, and he's using his thumb and fingers to pull the string, instead of just his fingers.

J. L. OBERLE, Jeffers, Minn.

You're right. The arrow shaft should have been on the left side of the bow. However, the archer was expert in aim: His arrow ignited the fumes

. . . The practice of using a bow and arrow to light the furnes of an excess tower was discontinued here at the Phillips Chemical plant some years ago. We now use a 37-mm, flare pistol,

Its use is not complicated, but you do have to figure the direction of the wind and your distance from the base of the tower to allow the fire ball of the flare to burst in the fumes. We very seldom have to light the burners because they have a pilot light on them.

J. A. CALHOUN, Borger, Tex.

You Can't Fight Progress

Last year I went to the Allis Chalmers plant in Wisconsin and saw their newest tractor ["Electric Tractor Makes Its Own Juice," Feb.]. At the time, I didn't see the many possibilities for the future brought out in your article. If electric cars are really coming, I'm wondering about two things:

 If they're practically noiseless, won't a lot more pedestrians get bumped

crossing the streets?

2) Won't workers in oil companies and service stations lose their jobs?

MICHAEL PERSHING, Glencoe, Ill.

1) That's what people said when the Stanley Steamer was competing with the gasoline buggy.

2) That's what they said when horseshoes, carpet beaters, and gas mantles lost out to tires, vacuum cleaners, and electric-light bulbs.



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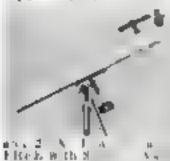
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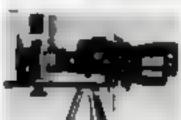
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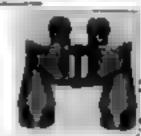
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The month in science

Where oil comes from. When you savor the aroma of a pine forest, you're sniffing petroleum of the future. For oil in the ground starts out as smells in the air, according to a new theory outlined by Dr. Frits W. Went of St. Louis' Missouri Botanical Garden.

Dr. Went's explanation solves a mystery that has puzzled scientists for years. The origin of coal was obvious—you can often see the remains of ancient trees in it—but liquid black oil offered no solid clue to its beginnings. The best guess, never completely accepted, had been that petroleum came from the decayed bodies of tiny animals and plants that settled to the bottoms of oceans.

Now Dr. Went points to "blue haze"-the faint smog seen over fields and forests in the summer-as the starting point for



petroleum. The haze comes from plants, which evaporate compounds of carbon and hydrogen into the atmosphere. These volatile hydrocarbons make the pungent smell of steppes, the sweet odor of meadows, and the aromatic scent of pine forests. They are the raw materials for a marvelous series of chemical reactions, unappreciated until now, that are always going on in the air overhead.

The hydrocarbons mix with oxides of nitrogen (lightning manufactures them from the elemental oxygen and nitrogen that makes up the earth's atmosphere). Then ultraviolet rays—from sunlight—condense the hydrocarbons and the nitrogen oxides, forming ozone (oxygen with three atoms in each molecule instead of the ordinary two) and tiny particles of tarlike substances.

What happened to the blue haze had also been a puzzle. The amount of hydrocarbons that plants throw into the air is formidable: 175,000,000 tons every year. And plants have been doing that for millions of years. It obviously doesn't accumulate

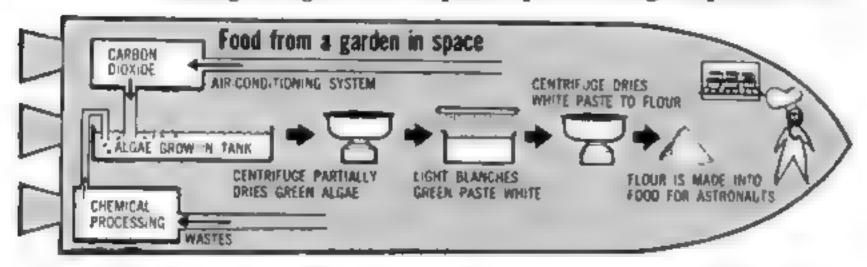
The month in science continued

in the atmosphere—the whole world would smell of pine and hay. Besides, the stuff is combustible and would have exploded.

Dr. Went neatly ties up this mystery with the origin of oil. He says that rain and snow form around the tar dust, washing it to the ground. There it mixes with clay. Rivers erode the clay, eventually burying the mixture beneath lakes and oceans. After millions of years have gone by, the clay has been petrified into porous rock and the tar particles have been squeezed into petroleum that fills the rock pores—an oil field.

Pass the algae cake, please. Boeing scientists have revealed a major breakthrough in the race for space (gastronomic division). They figured out how to grow algae that taste good (better than hay, anyhow).

Packing enough food for space trips seems nigh impossible: The



voyages will be so long that a stock of even C-ration and Hershey bars would weigh too much. The neatest way out would be to make the astronauts grow their own food. The rocket-ship garden could re-use the crew's body wastes (which have to be gotten rid of somehow), and also regenerate oxygen for their air supply; a very economical arrangement. The favored crop is algae, the tiny plants that make the scum on ponds. Algae are very nutritious (the experts insist), but they look nauseating (green) and taste like rabbit food.

The Boeing researchers cultivated algae by bubbling carbon dioxide through kids' plastic wading pools that were filled with fertilized water. After five days, they harvested the scum, centrifuged it into a paste, and then blanched the green paste white with very bright lights. The white paste dries to something that looks like flour. Chief biochemist Arthur J. Pilgrim took some of the algae flour home to his 14-year-old daughter Vicki, who made cookies and cupcakes out of the stuff (mixed with less esoteric ingredients). Tastes fine, they say.

Fly slow to get there fast. If you want to go from New York to Chicago in a hurry, you save time by not taking the fastest plane. It sounds ridiculous, but the schedules prove it's true.

The 575-m.p.h. jet DC-8 takes off and lands at airports (Idlewild and O'Hare) which are farther out from the cities than the fields (La Guardia and Midway) used by the 400-m.p.h. turboprops. You lose more time traveling that extra 21 miles on the ground than you save in the air. This is progress?

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PS Puzzlers By Joan Steen

Some hurdles for the nimble-witted . . . Answers on page 220

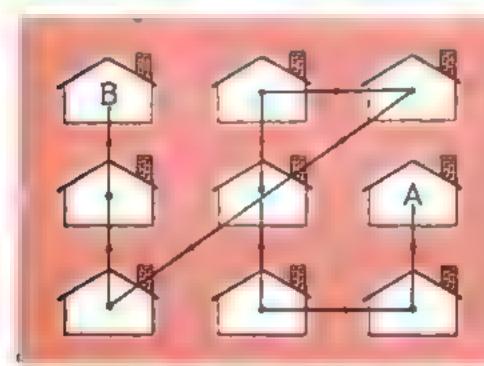


The Curious Community of Shangri-La

MATHEMATICIANS have long since exhausted the charms of dice-throwing or coin-tossing. Now they theorize about more sophisticated games such as poker, bridge, or chess—where skill as well as chance is involved—or dream up tantalizing tales like this:

In the Curious Community of Shangri-La, the priests dictate a universal game that everyone must play. Every night each citizen of this impovershed and isolated state goes forth to the temple where he deposits a sealed self-addressed envelope that contains any amount of money. The priests collect the envelopes, shuffle them, and match them up in pairs, (There is an even number of people.) Each pair of envelopes is then opened by an outside philanthropist who takes out (and keeps) the money he finds in them. He puts a dollar back in the envelope that contained the larger sum. If there's a tie he tosses a coin to decide who gets the dollar. The priests then collect the envelopes and return them to their original owners.

Now, as a poor Shangri-Layan, how would you play this game to win? Surely you wouldn't put in more than a dollar. What would be your smartest bet?



TIKE straight-line problems?

The butter-and-egg man in this small farming community of nine houses starts from his house (A) and makes daily deliveries to his eight neighbors, ending, for reasons known only to Sam Loyd—the famous puzzle expert who made this one up—at house B. He can do it in six straight moves (see diagram). But surely you can do it in fewer. (Lazy as I am, I stopped at five. Sam did it in four.)

HERE'S a true-false logical puzzle in the form of a murder mystery:

Hank Miller, a small-time gambler and racketeer, was shot and fatally wounded in front of the pool hall in Smalltown. A few days later the police rounded up three suspects in nearby Bigtown. All three had long police records and the police were convinced one of them was

the culprit. The trouble was that each was incapable of making three consecutive statements without lying.

Here's what each of the suspects said in his defense:

Lefty: Spike killed Hank,

I never was in Smalltown in my life.

I'm innocent.





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PS Puzzlers continued

Spike: Red is innocent.

Everything that Lefty said is a

lie.

I didn't do it.

I didn't kill him. Red: Lefty lied when he said he'd never been in Smalltown, Spike lied when he said every-

thing Lefty said was a lie.

Who killed Miller?



TO SETTLE all arguments you I could solve this puzzle by chemical analysis, but then we'd have to ask you to turn in your puzzler's badge:

Two glasses of equal size are each

half filled: one with vinegar, the other with water. A teaspoonful of vinegar is removed from the vinegar glass and poured into the water glass. Then a teaspoonful of this mixture is poured back into the vinegar glass.

Question: Is the quantity of vinegar in the water glass now greater or less than that of water in the vinegar glass?

LITTLE auto know-how and you too can catch this lady in a lie:

Mrs. Johnson came out of the hat shop one bright spring day just as Officer Murphy came up, ticket book in hand

"I know it's a fire zone," said Mrs. Johnson, "But my daughter is getting married and I had to stop off to pick up my new hat."

"Yes, ma'am," said Officer Murphy

agreeably. "But you are in a fire zone."

"But only two minutes, When I stopped, that big jeweler's clock was at 12:27, and it's not 12:30 yet."

"Lady," said Officer Murphy, "if you were really here only two minutes, I'll forget it. But if you were here longer, a ticket you'll get."

Walking behind the car, he paused a moment. Then he wrote a ticket. Why?

Puzzle of the month



"HIS one comes from the creator of Alice in Wonderland, who, when not producing children's classics under the pen name Lewis Carroll, produced mathematics under his real name: Charles Dodgson. This puzzle is one of the "Knots" from A Tangled Tale, a Carrollian work.

An old and a young knight were returning wearily from a walk that had taken them from straight road to

Answer to last month's P-O-T-M: The Census Taker. You're looking for three numbers which are all divisors of 225 and which add up to the house number-unknown to you. Now this would be insoluble for a distinct set of numbers, except for the fact that the census taker, who obviously knew the house number, nevertheless had craggy mountain path and back again. They walked four miles an hour on the level ground, climbed the mountain at three, and descended at six.

"Twas three hours past high noon when we left the hostelry," the old knight said, "and 'twill be nine by the time we regain it. Full many a mile shall we have plodded this day."

"How many? How many?" cried the

eager young knight.

The old man was silent, "What time was it when we stood on yonder mountain peak? Not exact to the minute . . . within one poor half-hour will do. Then I will tell thee how far we have trudged betweet three and nine."

Can you? (Answer next month,)

to ask an additional question: "Are you the eldest?" He must have had to choose between acts of numbers that not only multiplied to 225 but added to the same sum. There are two such sets: 15, 15, 1 and 25, 3, 3. (Both add to 31.) Clearly if there is an eldest, the ages must correspond to the second set.





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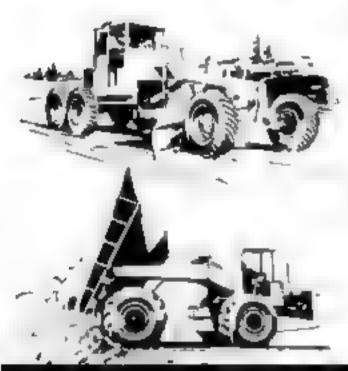
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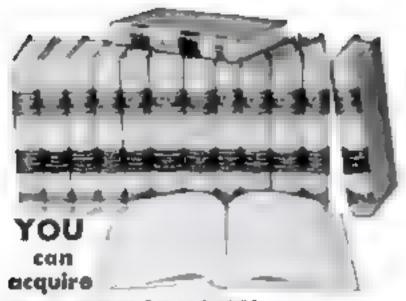
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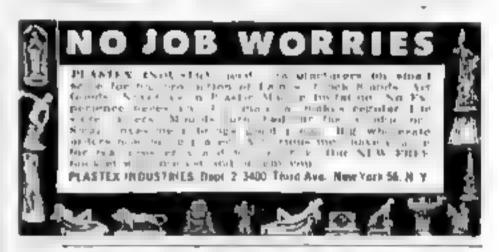
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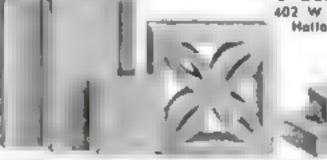


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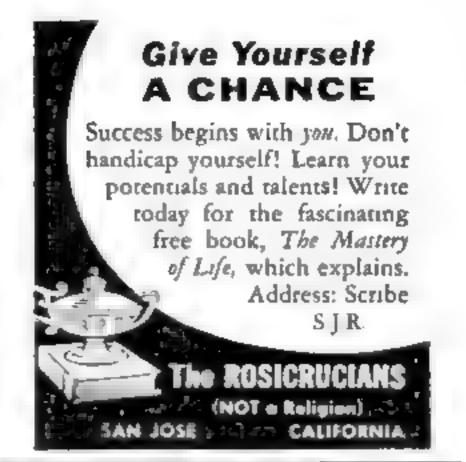


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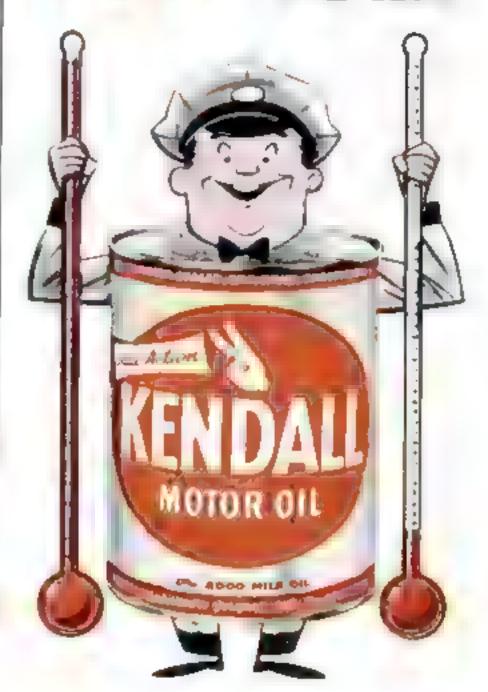
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By Paul Stag

Flow would you like to eatch more fish than you ever caught in your life? How would you like to catch fish when they're not but, for other fashermen on the lake? How would you like to never come home empty hander

I a been taking for over twenty five years. For the most a next every kind of late I've et a season of the analysis of the Andrews like the I've and I then the Season of the troop they caught motions. But now I have for full an interpreted line that gatalies fis better than any left I at a

I we caused thish time after time where other fix er sen have come home empty hander. I've caught fish on the Vivil when even had but talled! Vivil has caught fish for me at all hunrs of the day ... at all known of weather. This amazing hare made fish but his propoduce. I stylice the enclasive rigotic to prove in statement: "This is the finest hare ever an vented."

A French invention

The abusing we was towerful in France of a French sport man who named it 'Visit' the sport years testing every possed found of lare un fish and watching more they reacted to each cure under water! Who ever did that reforc? From those years of testing it is French man developed Ytysfall, the patented fore with the "Live" tail

When he started selling Verif in France is became one of the largest selling fish luces in Europe! Soon its fame spread to as foreign lands! From all over came increased repurs of how Vivil caught fin

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Soldom if ever has a fish fure received such on exciting reaction from fishermen. Amazing catches have been resorted from all over the world in England. Vivid holds a Bratch record! In 25 foreign lands Vivid is eatching fish like magic. Already reports from fisher men in this country are posting in . . . reports saying Vivid is the greatest lare they have ever used. Fishermen in 25 countries can't be wrong. "Vivid is the finest lure I have used in 25 years of fishing!"

has made amazing catches in Australia Denruark. France, Germany. Scare Mana and Carety

Last winter I started important. Visit retimerical I are it to expel experienced by exact the country of the many of executive and the country of the coun

that was more important the son in what wher areface fishermen say. Here a a typical letter from Mr. Robert Hilton of tack smooth, Florida, "I have used artificial lives from Canada to Florida and have worn not me spinning reds. The VIVIF is far anyearer to any live that I have ever used. The day I used Vivil the base were not luting, even on live shaper. I caught 6 have on that and then but it to a large but I have on there and then but it to a large but I have a great mater three times term in the way of large after he or see my 12 points absentill.

From everywhere come their reports of how had makes fish bite like magic . . . of the magic appeal it seems to have . . of how it not lisher and our-catcher any lare they have ever used

Why is this true! Frankly I don't know All I know is that Vivil is different from any large violence in the water. It even keeps moving on a dackgood free! You it is pure minimum in boss packgrel pake senot and other give fish

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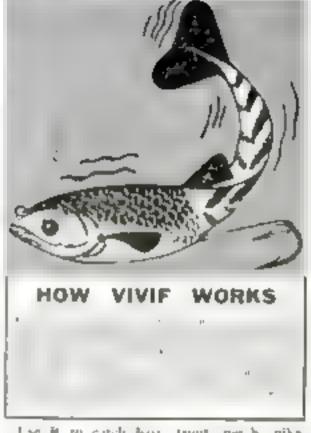
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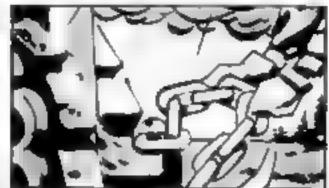
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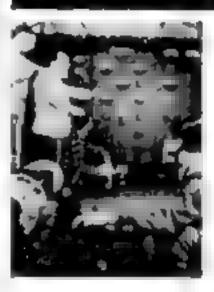


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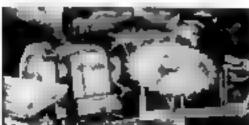
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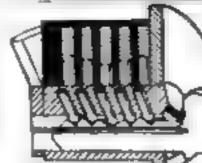
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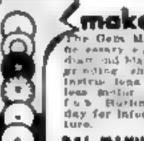
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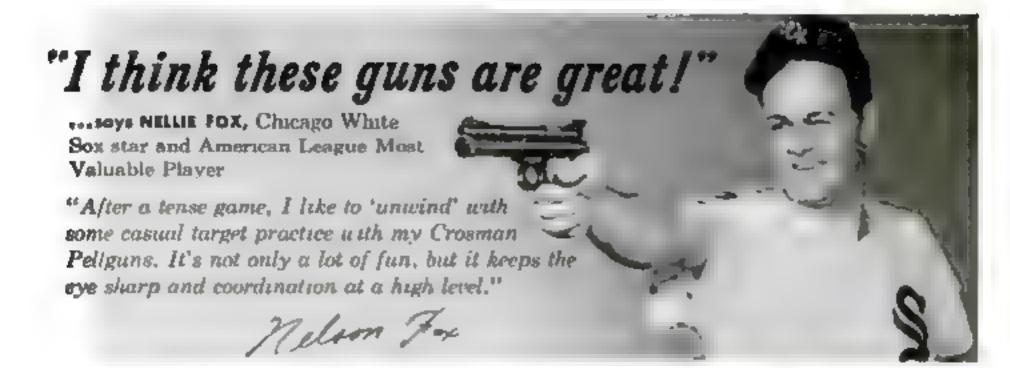
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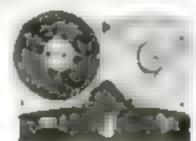
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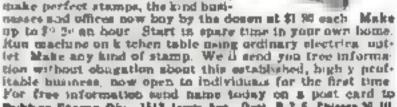
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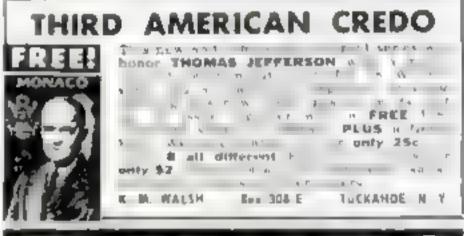
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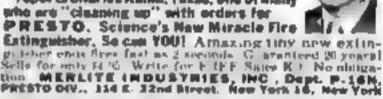


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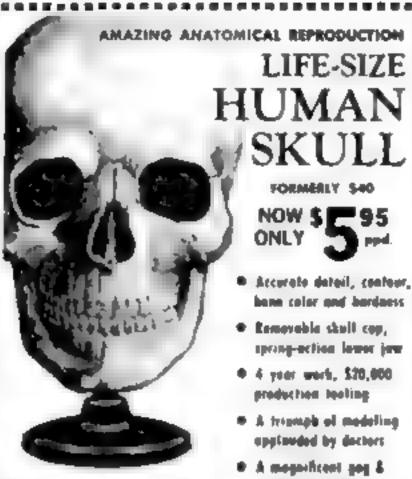
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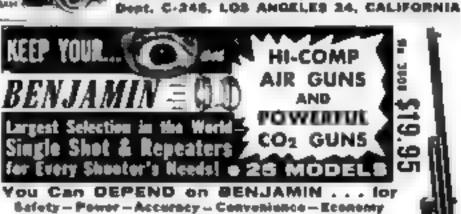
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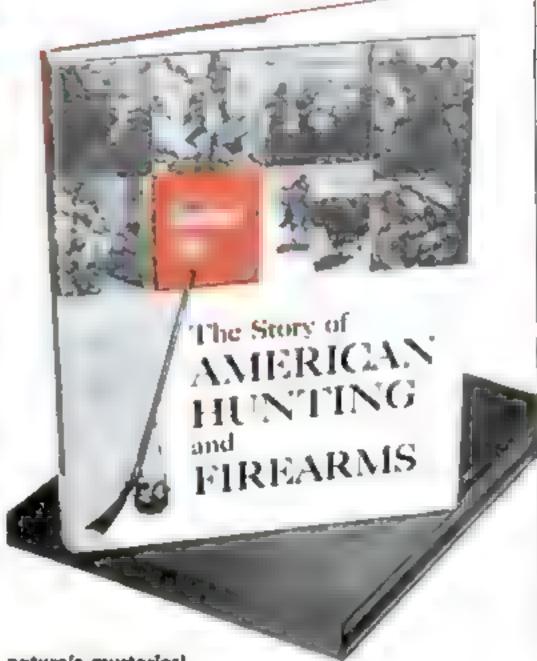
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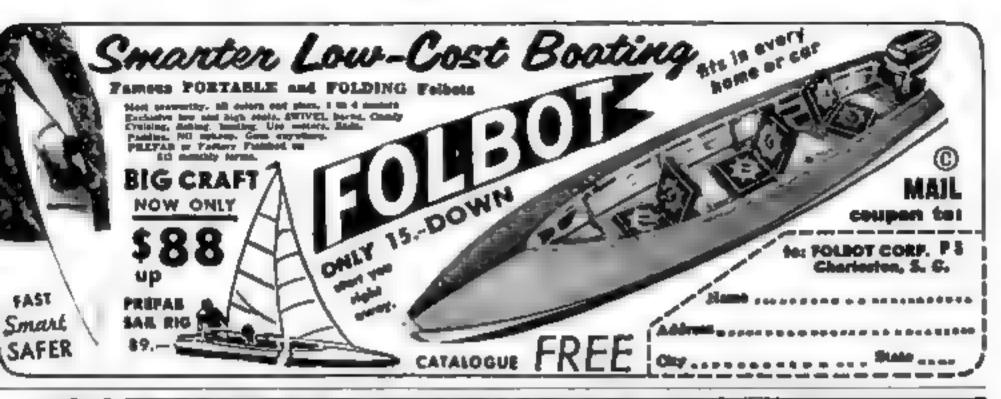
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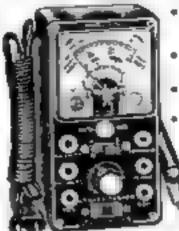
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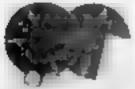
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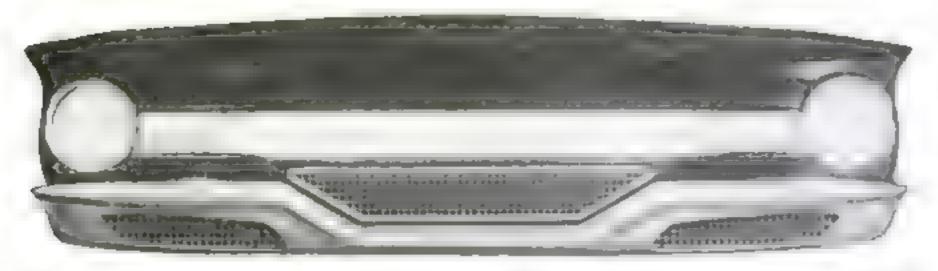
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By Ken Fermoyle PS Detroit Editor

Car-Wide Headlamps Coming?



Fluorescent headlights. Development of a lighting system with a brightness level 338 percent greater than any fluorescent unit commercially available might make fluorescents practical for automotive use. Sylvania Electric recently showed a prototype headlight that combines its new fluorescent "aperture lamp" with conventional high-beam lamps for highway driving. The experimental headlight extends across the grille, between a pair of normal incandescent headlamps.

The new system throws an optically controlled narrow band of light ahead of the car. Sylvania claims that it distributes light more uniformly immediately in front and to the sides. A sharp vertical cut-off keeps glare from reaching the eyes of oncoming drivers. Says Sylvania: "When used in conjunction with the high beam, the system is ideal for high-speed driving and gives the advantages of the fluorescent lamp's greater efficiency and longer life."

Also gets rid of the four-eyed look.

Early bow for Pontiac's compact. Tentatively named the Panther, this new compact could be in production by June and set for public introduction in August. You hear rumors of early introductions every year in Detroit, and they're usually false. This one could be the McCoy, because Pontiac—and Buick and Olds—are anxious to get their smaller cars on the market.

Pontiac's work on a four-cylinder, inline engine for the car seems to have been a red berring. Using such an engine, when other U. S. compacts have sixes or small V-8s, could put the Panther at a competitive disadvantage. The car will have the 215-cu.-in. V-8 set for the small Buick and Olds. Bore of the V-8 is 3.5 inches, Stroke is 2.8 inches, The V-8 eventually will be aluminum, but maybe not for 1961.

Rubber gas tanks. A puncture proof version developed by a major rubber company looks to some engineers like the solution to the problem of producing

odd-shaped gas tanks. Recent car designs have some weirdly shaped tanks, and forming them is a headache. Also, the rubber job is nearly indestructible.

New shift for Fordlets? Maybe, for 1961, rumors say. A new three-speed, lightweight automatic transmission is on the drawing boards in Dearborn. It's reportedly slated for the Comet, if en-

gineers can build it for a reasonable price. It might go in Falcons, too.

Comets will use bigger engines in 1961. Original plans called for current models to use a stroked version of the Falcon



The extra demands of racing prove high performance of Autolite Spark Plugs



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DETROIT REPORT continued

170-cu.-in, six, bringing it up to about 105 hp. But the car was introduced earlier than planned, leaving insufficient time to ready the bigger engine

Some dealers selling Big Three compacts in big metropolitan areas report that 90 percent of their customers want automatic transmissions. (Ford and Chrysler are having trouble building enough automatic-equipped Falcons and Valuants to meet the demand.) This is one reason Ford plans tentatively to offer a three-speed automatic transmission next year.



Falcon Ranchero pickup. Ford chopped the Falcon greenhouse off back of the front seat, replaced the back seat and trunk with a pickup bed, and came up with what it calls, at \$1,862, "America's lowest-priced pickup truck with turn indicators and oil filter as standard equipment." The qualification is necessary because Studebaker's Champ pickups list for less.

The Ranchero uses the standard Falcon engine and running gear—with a few changes to springs and shocks to fit it for truck use.

As the picture at left shows, it looks identical to Falcon cars when viewed from the front.

Fuel injection again. A low-cost fuel-injection system developed by Thompson Products interests Detroit engineers. It can be built for \$50 with a production volume of 150,000 units, and possibly for just \$35 in bigger quantities.

A timed-injection system, which engineers think is better than a continuous-flow setup like Chevy's, it's cheap because Thompson Products eliminated tight clearances that run up machining and assembly costs.



Compulsory seat belts? A bill requiring seat belts on all new cars sold in New York after July 1, 1961, has been

announced by the New York Joint Legislative Committee on Motor Vehicles and Traffic Safety. Its sponsors say experiments show that use of belts reduces the likelihood of injury in an accident by 60 percent and of death by 50 percent. They figure the measure might cut the state's highway death toll—now over 2,000 a year.

Volvo plans 100-hp. sports car. The Swedish firm's sports model goes into production in September. Bodies will be built and the cars assembled in England because Volvo factories in Sweden are working at full capacity to meet demands for present models.

The car's 1.78-liter (108.6 cu.-in.), four-cylinder engine is based on the standard 85-hp., 97-cu.-in, engine, It

uses a four-speed manual gearbox with optional overdrive. It has power brakes, with drum brakes on rear wheels, disk brakes up front. Instruments include tachometer, tripmeter, oil-temperature gauge. Volvo sedans are noted as the hottest performers among imports of their price and size, so sports-car fans are looking forward to the debut of the new model.



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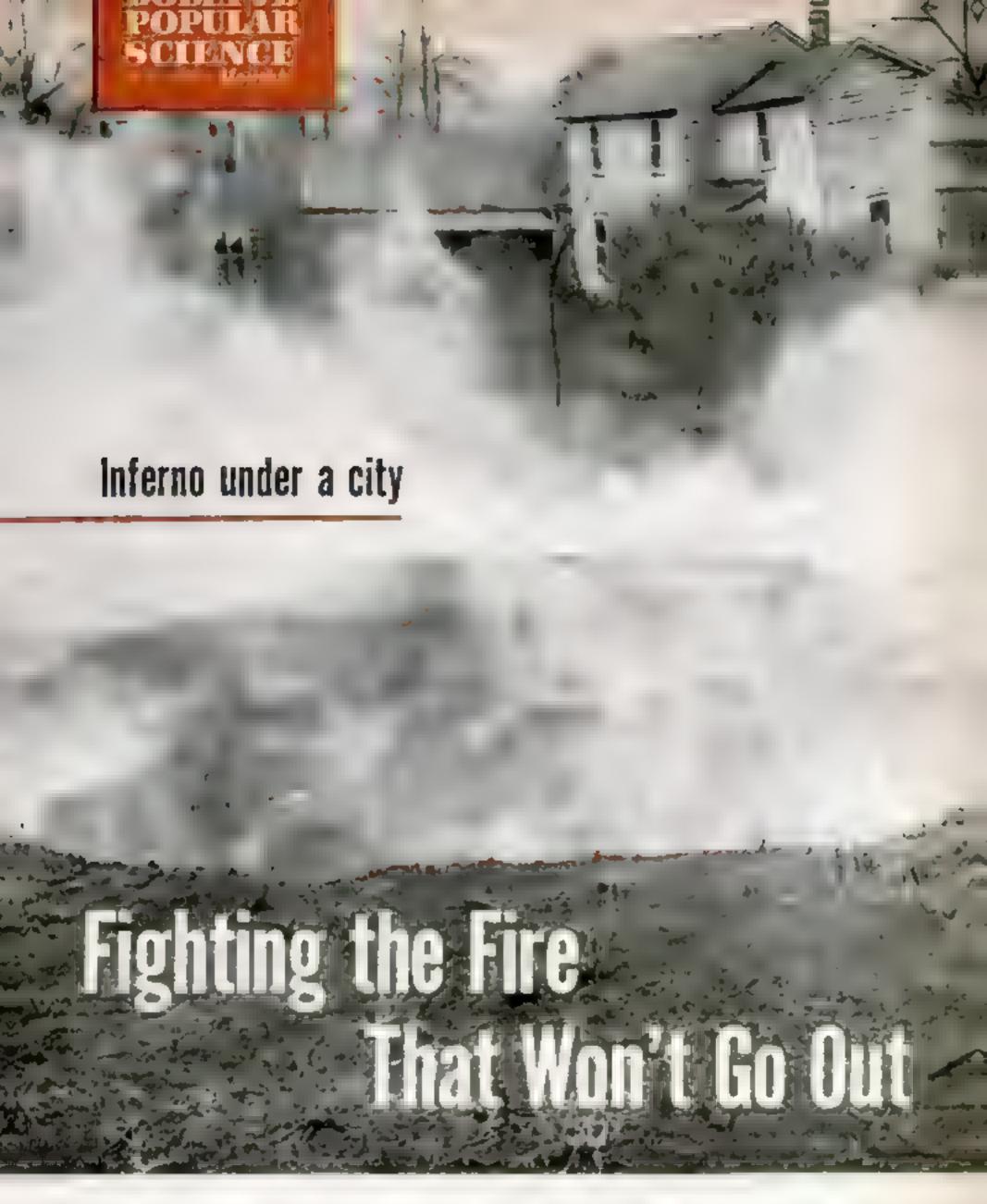
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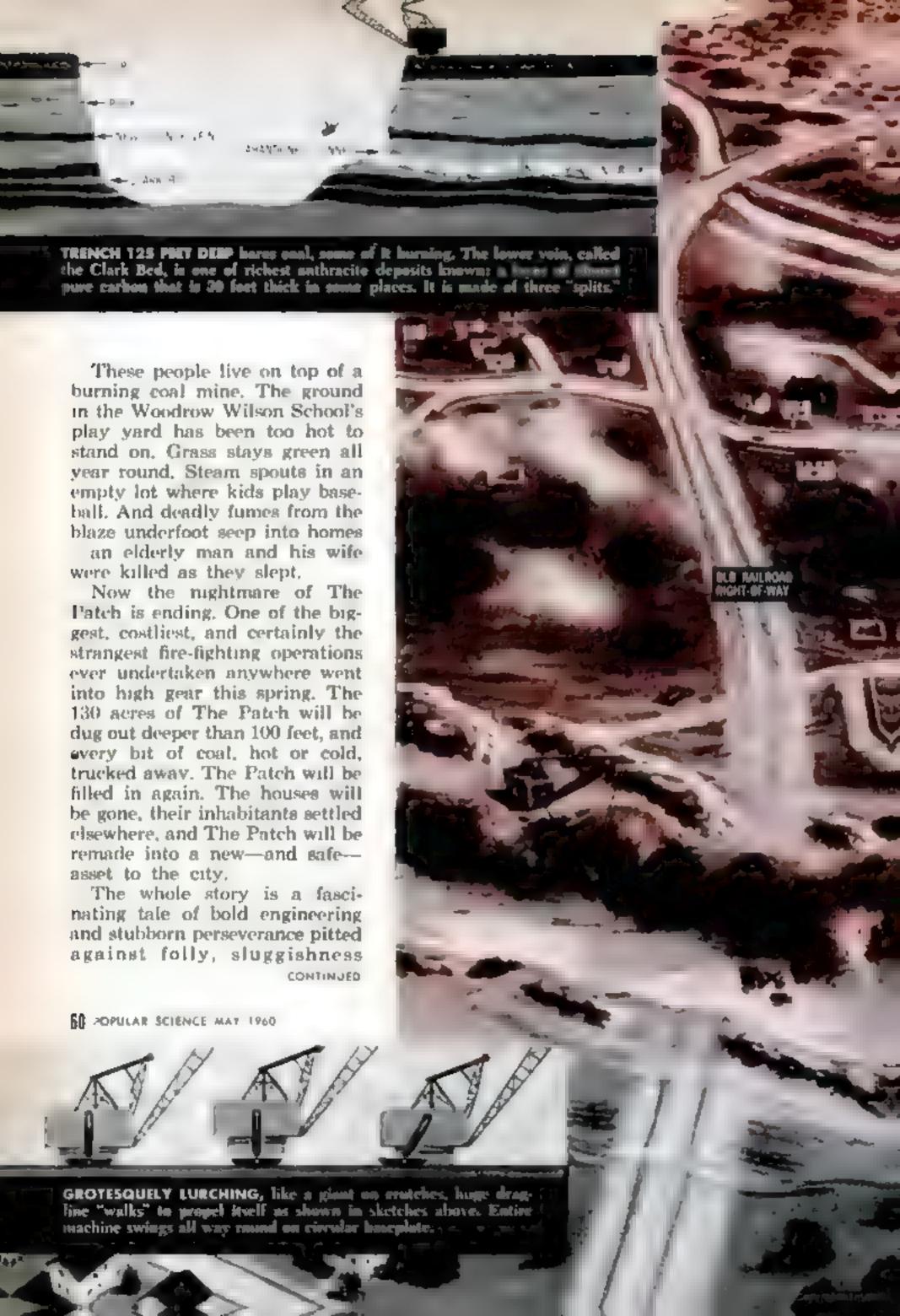
EVINRUDE



For 14 years, 1,200 people have lived atop a blazing coal mine. Now their nightmare is ending

By Martin Mann

Patch in Carbondale, Pa, always leave their cellar doors unlocked That's so inspectors, instruments in hand, can come in any time of day or night—to check for poisonous gases.



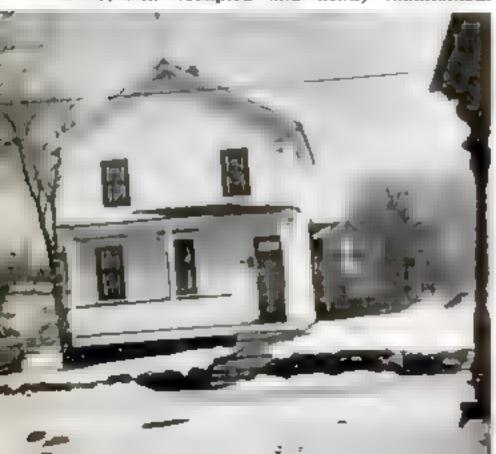


The Patch is doomed, but its people hang on in tilting homes, ever alert for gases that kill in the night



FIRE CAN BE SEEN in this pit mine being worked. just north of Carbondale's residential area. Pool of water shields shovel and truck from heat. Abandoned mine tunnels show up as black circular openings to the left of the shovel.

FULL CUP OF COFFEE IS HARD TO GET in this home, still occupied and neatly maintained.



and despair. Now the good guys are winning at last.

How it started. Gray old Carbondale (pop. 14,000) sits in the rugged scenery of northeastern Pennsylvania's Lackawanna Valley. But natural beauty (lately pimpled by mine dumps) was not to be its fortune. That lay underneath the scenery: thick, rich veins of anthracite coal. Millionaires were made as canal barges and, later, railroad hoppers, hauled the smokeless home-heating fuel to eastern cities. Today, of course, competition from natural gas and oil has all but ruined the anthracite business.

The first coal dug in Carbondale came from The Patch in 1819. Since then this piece of land has been mined, re-mined, and mined again. Tunnels and roomsnow loosely filled with the "gob" of broken rock, waste coal, and junked timbers-riddle the earth beneath the houses. All around, coal is being dug right now: a Gillen Coal Co. tunnel sloping in from the south, open pits yawning

in every direction.

Strangely, there is still a fortune in coal under The Patch's doomed homes. Even after five generations of miners have picked through it, even after it has burned for 14 years, more than 2,200,000 tons of usable coal remain in the ground there, by the careful estimate of consulting engineer Robert W. Bell. And despite the poor market for anthracite, this mineful is worth a mineful of money: more than \$13,600,000. That silver helps

teaning in opposite directions, two abandoned houses illustrate how badly earth has





HELL IN AN EMPTY LOT: Cracks in earth spew vapor; grass is green, ground warm all winter. There was snow all around but none here.



Martin Campbell samples air in basement of handsome old house. Heat is always stifling here.

Sparking an injerno. The fire started when garbage was dumped into the openpit mine just north of The Patch—foolhardiness little short of playing with matches in a powder magazine. Garbage heaps are always catching fire (from heat generated by decaying organic matter). This one did, igniting coal around it.

Carbondale first knew it was in for trouble March 15, 1946. That morning North West Coal Co.'s foreman Joseph O'Byrne, making his routine start-of-the-shift inspection, detected carbon monoxide gas—underground, in a shaft near the smoldering garbage. No one anticipated how big this trouble would grow.

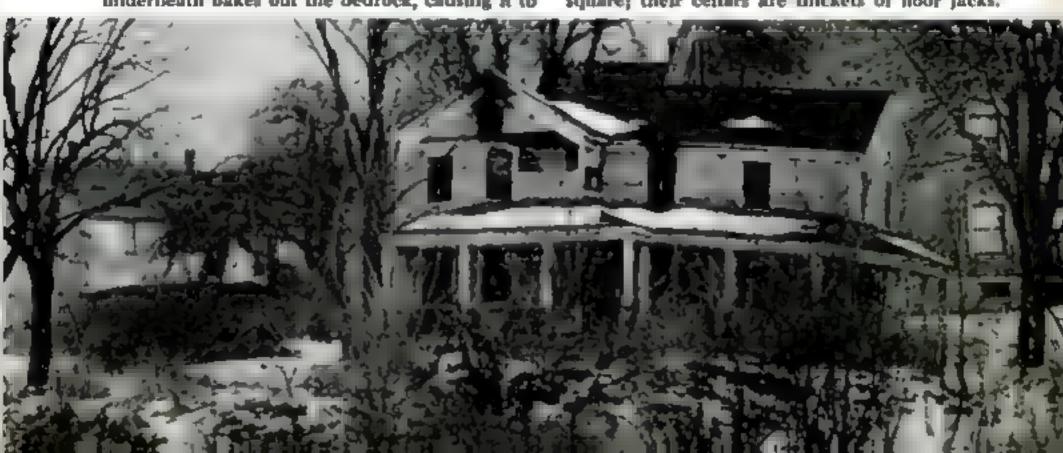
An underground coal fire is a complicated business. Solid veins of coal imbedded in rock are practically incom-

Even the loose bustible—no oxygen. waste coal in abandoned tunnels seldom flames the way coal does in a grate. What does burn is gases—carbon monoxide, methane (marsh gas), and hydrogenthat were trapped in the coal when it was formed hundreds of millions of years ago and that are released when the broken coal is heated. This explains one of the eeriest facts about the Carbondale fire: When you see it-where pit mining has exposed an old tunnel—the coal does not appear to burn. The rocks above it, where the gases seep out, seem to be on fire.

The gas-fed flames sometimes whoosh with explosive speed (1,000 m.p.h.) through man-made tunnels and natural fissures in the earth. Even the wind

[Continued on page 223]

settled. The ground collapses when fire deep underneath bakes out the bedrock, causing it to crumble. Few buildings in the area now stand square; their cellars are thickets of floor jacks.





EACH STEP OF ASSEMBLY is photographed incolor after an expert has done the work in the most efficient way. He then helps prepare a tape explaining how he did the assembling.

WITH VIDEOSONIC'S HELP, a smart housewife with no factory experience can learn to assemble an entire electronic unit after running through a set of pictures and tape five times.

Tape-and-photo teacher cuts work errors

There's hardly ever a mistake now on intricate electronics assembly lines at Hughes Aircraft Co. plants, thanks to Videosonic. It's an automatic instruction device developed by Hughes and installed at each person's work station. It shows just how a job is done on colored slides

and explains each step on magnetic tape. A learner listens through earphones, can stop the tape and slide projector at any time he wants to linger over a point. Experienced assemblers often refer to the device to refresh their memories when confronted with a difficult job.



BALES OF HAY ride on elevator to loft door in the barn with only one man on the truck.

TIPPING OFF to left or right is done by locator operated from outside by a control rope.

Automation on the farm

Stacking a barn with bales of hay can now be done with conveyors—with no one on the inside and only one man on the wagon to handle the controls. This New Holland bale carrier consists of light steel sections bolted together to form an elevator and overhead conveyor system. Baffles guide bales around corners, and a locator operated by the man on the truck tips them off

64 POPULAR SCIENCE MAY 1940



WHICH SIGN DO YOU READ? Author Kearney puzzles over flagrant stupidity. This excellent

six-lane divided highway through Long Island meadows is heavily traveled—at about 50 m.p.h.

Safety Expert Urges:

Let's Abolish Stupid Speed Limits

By Paul Kearney

The writer of this article, a noted authority on driving safety, and winner of the \$1,500 Ted V. Rogers Journalism Award for a PS article, argues that speeding is a greatly over-emphasized factor in accidents. Because his view point is controversial, advance copies of the article were shown to officials known for their speed-consciousness. Some of their comments are printed on the following pages.

Route 13, there's a fine stretch of four-lane highway. Straight and level, it runs through an unpopulated area. You can be arrested for speeding on it if you are clocked at 32 m.p.h.—it is posted at 30. Nearby are miles of winding blacktop road, narrow and rough, on which you can legally drive at 50 m p h.

Similar unrealistic speed limits can be found in every state of the Union. True,

Are Speed Limits Foolish? Backtalk from Authorities:

From Robert Moses, New York's pioneer builder of parkways, sharp and testy dis-

agreement.

"I do not know Mr. Kearney, but doubt if he has had the daily experience of reviewing accidents over a long period of time. Our experience and records over the years show that the difference between a fatal accident and a minor one is almost always a matter of excessive speed.

"I do not know why a reputable magazine like POPULAR SCIENCE would bother with

this kind of stuff."

From the office of Connecticut Governor Abraham Ribicoff, a firm defense of his crackdown on speeders.

"Every writer is entitled to his opinions on this subject. We feel that the results of

conscientious police don't try to enforce the more foolish speed limits. But enforced or not, they still have two harmful, even dangerous, effects:

 By teaching every driver that he must make up his mind if a posted limit is rational or not, they encourage an off-

hand attitude toward the law.

2. By making a fetish out of speedlimit enforcement, they lead police and highway-safety officials away from the more basic causes of highway accidents: the drinking driver, and the inattentive

or incompetent driver.

Speed: culprit or bogeyman? Not long ago, in the course of two lengthy runs on the New York Thruway, I noticed that lots of cars were zooming by me. For experiment, I kept at the legal limit (a true 60 m.p.h.) and kept count for more than an hour. For every car that I passed, six passed me. Later, as a check, I kept track during a run in the opposite direction; and for every car going at the limit or under, eight were topping it.

Now according to the "speed kills" theorists, that road should have a grim record. The facts are otherwise. That year the Thruway had the best safety record of all turnpikes—0.87 deaths per 100 million vehicle miles. Compare this with 5.6 deaths for the nation as a whole, or, more fairly, with 3.2 for the Ohio Turnpike.

The facts directly contradict the pablum we've been fed for years about speed being the source of all auto evil. Chauffeur-driven governors, judges, and highway-safety commissioners are constantly proclaiming a "crackdown on speeders" as the panacea. Some states have taken to calling out the militia to bag violators. And if perchance the accident rate does decline a bit, this is taken as proof.

It might seem so—except for the fact that other, calmer states have managed to reduce their accident rates more without such antics. Connecticut, ballyhooing its drive to revoke speeders' licenses, should perhaps ponder what Indiana has done.



SAFE CHANCE TO PASS TRUCKS is spoiled by unrealistic limit on new stretch—wide, straight,

not built up—of suburban road. This good piece (about one mile long) connects twisting narrow

the Connecticut safety program speak for themselves."

But from Howard Pyle, president of the ultra-cautious National Safety Council, an

apparent change of attitude:

The National Safety Council agrees wholeheartedly with Paul Kearney that the posted speed limits must be realistic and should be determined by engineering study of modern traffic, rather than by guesswork, obsolete laws, and outmoded conditions.

"We like his comments on slowpoke drivers, who can be dangerous. We believe the country will see more emphasis on minimum speed limits in the next few years.

"When the Council talks of speed, it talks of speed too slow or too fast for conditions, as well as speed in excess of posted limits. The need is for more uniform speed—not a mixture of slow and fast speeds—to reduce congestion and accidents.

"We believe that Mr. Kearney's article will help bring this about, and we urge everyone to read it."

to name just one state. It has achieved bigger drops in the highway death rate than Connecticut has, and for three consecutive years, without resorting to shotgun enforcement of rigid speed limits.

Being tough with rational people never pays off as well as being reasonable. Three years ago the Pennsylvania State Police began writing warnings instead of tickets for most speeders on the Turnpike. The first year, warnings outnumbered arrests 22,009 to 16,965. The fatality rate dropped 28 percent.

Speed crackdowns don't work because speed is not the major cause of accidents. The evidence has been piling up year after year, and has been ignored year after year by shortsighted officials who timidly cling to antiquated regulations.

Eight years ago, the Pennsylvania Turnpike found that three out of four reported accidents involved cars traveling 50 m.p h. or alower.

Five years ago, Indiana State Police analyzed 600 fatal accidents on rural

roads. Half occurred at speeds under 40.

Two years ago, the National Safety Council reported a study of 685,000 accidents: Eight out of ten happened at speeds below 40.

Two years ago, New York Thruway police attributed only 89 out of 1,898 accidents to speed—as against 126 to falling asleep, 664 to hitting deer, 1,091 to human error.

And now comes the final blast at the "speed kills" theory from no less than the U.S. Bureau of Public Roads. It reported to Congress last year, in "The Federal Role in Highway Safety":

"Driver involvement in accidents in terms of miles of driving is at its maximum at lower speeds. The rate drops with increased speed, reaching its lowest value at about 65 miles an hour, and then climbs again as speeds increase. Moderately high speeds are associated with the lowest accident rates, on highways engineered for high speed,"

These careful studies expose the futility of relying on rigid and obsolete speed laws to prevent accidents. But they give no license to ignore those laws so long as they exist. Many limits, perhaps most, are judicious. And no individual has the right to violate any law, however absurd it seems to him personally. He does have the duty to work for a change in the law. So let's have realistic speed laws.

What does kill? The majority of all accidents are the first mishaps for good drivers with unblemished records who were not speeding. They make the oftenfatal mistakes of inattention or drinking.

Dr. Horace Campbell, chairman of the Colorado State Medical Society's Automotive Safety Committee, says flatly: "Alcohol is the single largest factor in our



sections (righthand photo above), where passing is impossible and 30-mile limit makes sense.

motor-car accident situation. In fact, it is equal to all other causes combined."

Autopsies on crash dead reveal a shockingly high proportion of drinkers (not all of whom were legally drunk). The National Safety Council reports:

In Delaware: 55 percent of the fatal accidents in olved "HBD"—had been drinking—drivers.

In Maryland: Of 133 drivers who died within 12 hours after an accident, 57 were

legally intoxicated.

In Westchester County, N. Y.: Of 83 drivers in fatal single-car accidents. 73 percent had been drinking, 49 percent were drunk.

In New York City: Of 69 drivers killed instantly in 1957. 38 had significant amounts of alcohol in their blood.

Did speeding kill those people?

The second accident-maker is simple-minded inattention: woolgathering, dozing, doing any one of the million things everybody does behind the wheel when he should be singlemindedly piloting an automobile. Col. Frank H. Jessup, former Superintendent of the Indiana State Police, laid it

on the line: "It is the occasional lapse of otherwise safety-minded drivers that is adding to the daily toll. A few seconds' inattention in modern traffic is enough

to set up an accident,"

We all have "occasional lapses." Those who come through unscathed just have them at opportune times—the others become statistics. These lapses will multiply as roads and cars improve, for effortless driving induces wandering minds, Hence the classic turnpike pile-up; rear-end collisions involving cars going the same way, often with no skid marks to indicate braking.

Look at the revealing answers that the Oklahoma Highway Patrol gets when it asks, "What were you doing just before the accident?" Samples: "Putting a diaper on the floor" . . . "Loosening a shoelace" . . . "Getting pillow from back seat" . . . "Dropped cigarette" . . . "Pushing kid back on rear seat."

Yet we still give tickets to guys going six miles an hour over the limit-and send sympathy cards to menaces who

doze off at the wheel.

The light dawns. The long-overdue updating of U. S. speed regulations is beginning, although far too slowly. More and more states have set minimum speeds. And 20 states are considering increases in their maximum limits.

The change of heart in New Jersey, where iron-fisted enforcement of antique speed laws has been a favorite tactic, is notable. J. Raymond Manahan, Chief of the Bureau of Traffic Safety, urged reappraisal so that "motorists can devote their entire attention to driving instead of watching for police pursuers." He added, "If there is a wide disparity between actual driving

practice and the legal limits, it is usually the limits—not the drivers—that are wrong,"

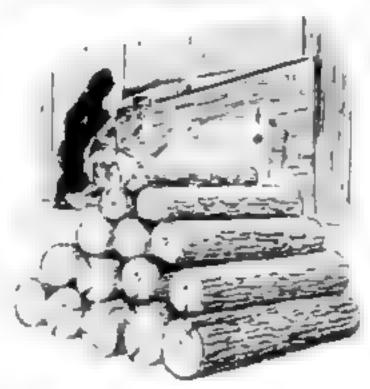
Such a common-sense approach does pay off. Two years ago Illinois studied roads where the posted limit was below the maximum for the state. The limit was raised in 1,167 zones, left unchanged in 619, and lowered in 23. This is what happened where the limits were upped:

Most people drove slower.

 Observance of limits jumped from 34 to 84 percent.

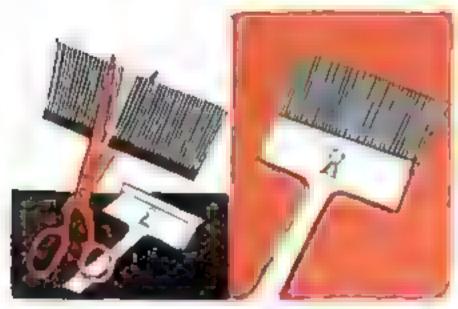
 Accidents dropped 35 percent. Few crackdowns have done so well.

Where'd it come from?



CORD: A length of twisted or woven strand (from the Latin chorda, meaning catgut). Originally a length of cord was used in measuring a quantity of cut wood in convenient size for fireplace burning The standard U.S. cord in 128 cubic feet of logs and air space. Usually it is arranged in a stack four feet high. four feet wide, and eight feet long.

"I'd like to see them make..."

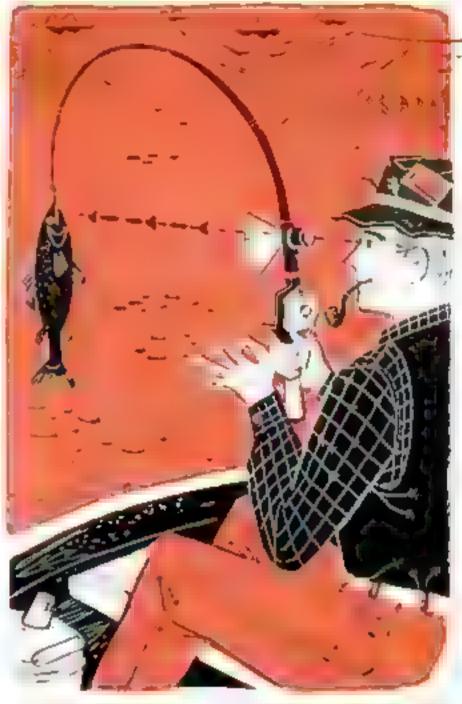


strips of bristles, cut off a piece as needed, and slip it into one of a set of various size holders.—

Joseph A. Stais, Riverside, Ill.



RATCHETS IN THE WHEELS of rotary power mowers to prevent them from rolling backward on slopes. A lever on the handle would release the "brake."—Roger Race, Saukvüle, Wis.



A WEIGHT GAUGE ON FISHING RODS. You'd sight past it to the end of the rod, and the rod's bend would indicate the weight of a fish.—Georga Williams, Portolla Valley, Calif.



A SOTTLE OPENER built into the doorpost of cars. All you need is an opening of the proper shape, and it would save a lot of frustration.—
M. Berger, University City, Mo.



WASHABLE PAPER MONEY. If coated with plastic, bills could be given a sudsy bath as needed and there'd be no more "filthy lucre" carrying germs.

—Jonas Martin, San Francisco.

Everyone has his own pet idea of a sadget that he would like to see in general use. The five ideas illustrated above were suggested by Portlan Schwen renders. What's

years? We will pay 45 for each one published. Please use Government postcards only. Write name and address clearly. Contributions cannot be acknowledged or reinteed.

Missile kills missile in air

In this dramatic sequence, a supersonic antiaircraft Hawk rocket intercepts and destroys an Honest John ballistic missile 1½ miles above White Sands, N. M. Photographs are from a film the Army made of the test.

The radar-guided Hawk left its launching pad when the Honest John reached the peak of its trajectory, and 15 seconds later—four miles away and changing course once in mid-air—met and blew up its onrushing target. The combined speed on impact was 2,000 m,p,h.



1. Honest John takes to air.

2. Hawk blasts off.



Mine sweeper is airborne

A special pod and winch enable an S-60 Skycrane to handle light mine-sweeping gear. In a Navy demonstration off Panama City, Fla., the copter at left carried the equipment aloft, lowered, towed, and finally retrieved it—without once becoming vulnerable to a mine.

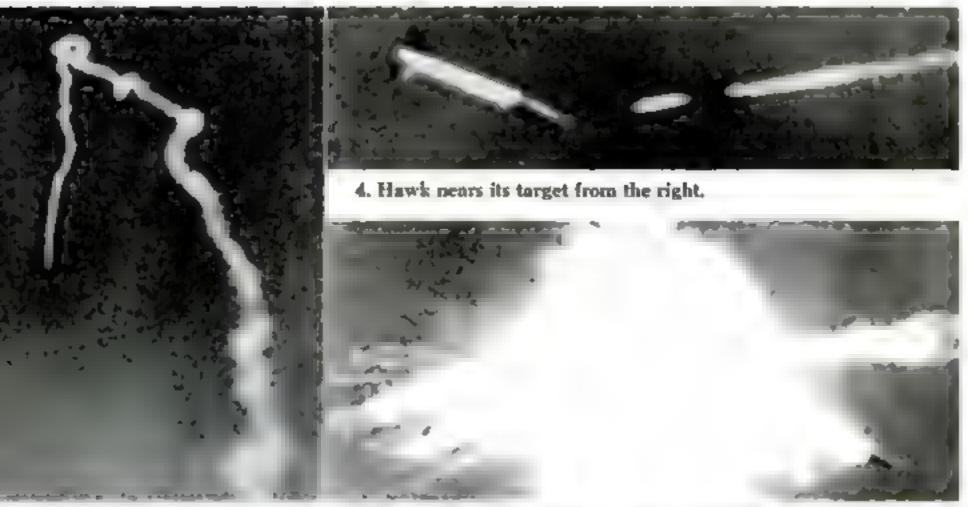
Bee-catching vacuum tube

Bees are vacuumed right out of their hives through a plastic tube into a 350-m.p.h. wind tunnel (at right in photo) and blown against a test section of plane windshield

Chance Vought engineers then try out the effectiveness of various windshield-washing detergents.



TO POPULAR SCIENCE MAY 1960



3. Changes course to intercept.

5. Honest John destroyed-mission accomplished.

London taxi for U.S.A.

Americans remember London for its taxicabs. You can get into one without taking off your top hat if you wear a top hat.

The diesel cabs are made by Austin—to specifications laid down by Scotland Yard. They are being sold here by Petzold Motor Sales, Detroit.



The same of the sa

Double-deck span

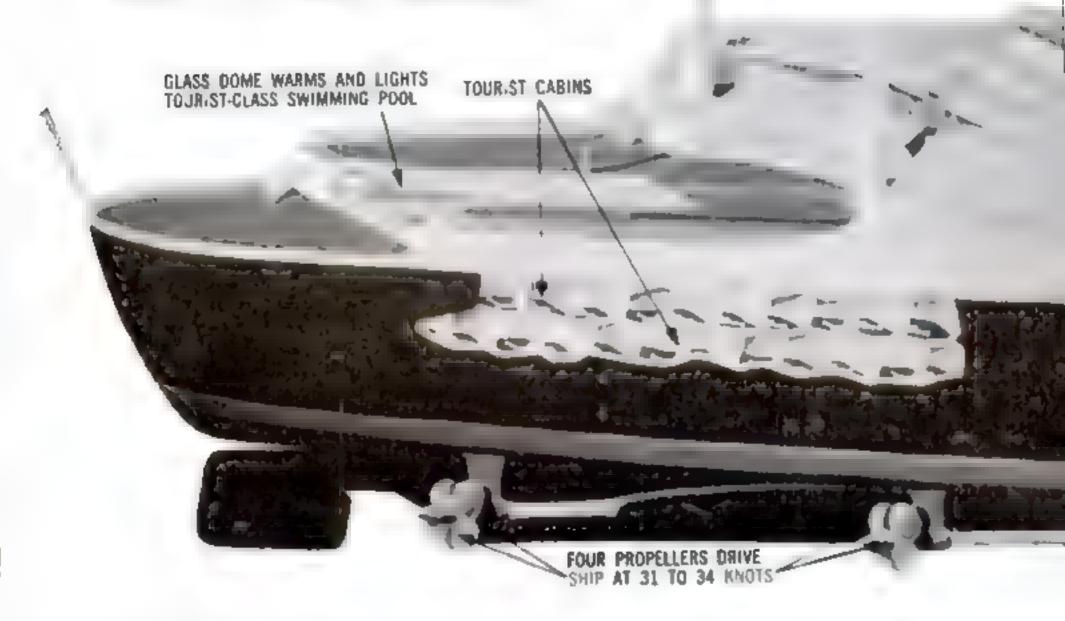
This 1,600-foot steel bridge across the Ohio River from Louisville, Ky., to New Albany, Ind., is scheduled to be opened to traffic next year.

It's a tandem, tiedarch, double-deck design that called for building techniques used before on only one other bridge that over the Carquinez Strait in California.

Each deck will carry a 42-foot, triple-lane road with walks at both sides.

Voila! Now the French Build World's Longest

Besides sheer size, the SS France will offer air conditioning, private baths, and TV to its 2,000 passengers



By Gardner Soule

THE drawing above, which continues onto the following two pages, shows you what \$86 million looks like when it's turned into a superliner for the North Atlantic trade.

The vessel is the French Line's France. Two years abuilding, she'll be launched this month at Saint-Nazaire, sliding down the same ways used in 1932 by the Normandie, France's last holder of the transatlantic speed record.

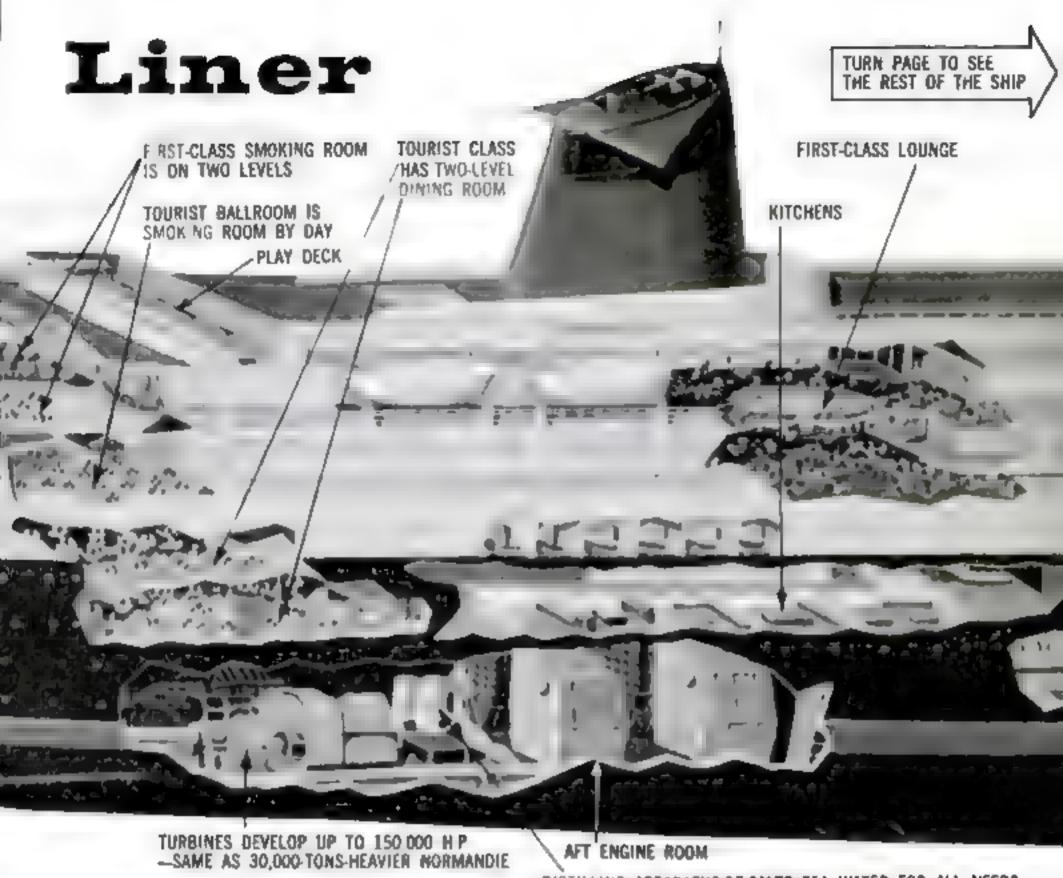
Due to enter service in September, 1961, the France will be the longest passenger ship in the world—1,035 feet overall. She noses out the Queen Elizabeth by four feet, the United States by 45 feet.

Her beam will be 110 feet. The Queen Mary and Queen Elizabeth are 118 feet; the United States 101 feet. She is all-welded—no rivets,

Like the 53,000-ton United States, the France will be a light ship—55,000 tons. There's lots of lightweight aluminum in both. The French ship will be low in silhouette, with nine decks, against the 12 of the United States.

Comfort is the thing the French Line people like to talk about. That's the lure to attract 500 first-class and 1,500 tourist passengers for each voyage. Every cabin will be air-conditioned and will have TV and a private bath. All decks will be open to tourist travelers—no shut-out feeling.

Her turbines will rest on vibration-ab-



DISTILLING APPARATUS DE SALTS SEA WATER FOR ALL NEEDS

sorbing mounts. Two pairs of stabilizers will minimize rolling. The ship is so long, they say, that in most weather she'll ride the crests of three waves at once to minimize pitching

They talk safety, too: Fifteen watertight compartments. Two far-apart engine rooms-to make it unlikely that both would be knocked out by underwater damage. And schedules: The engines will have reserve power to buck any storms the North Atlantic may offer

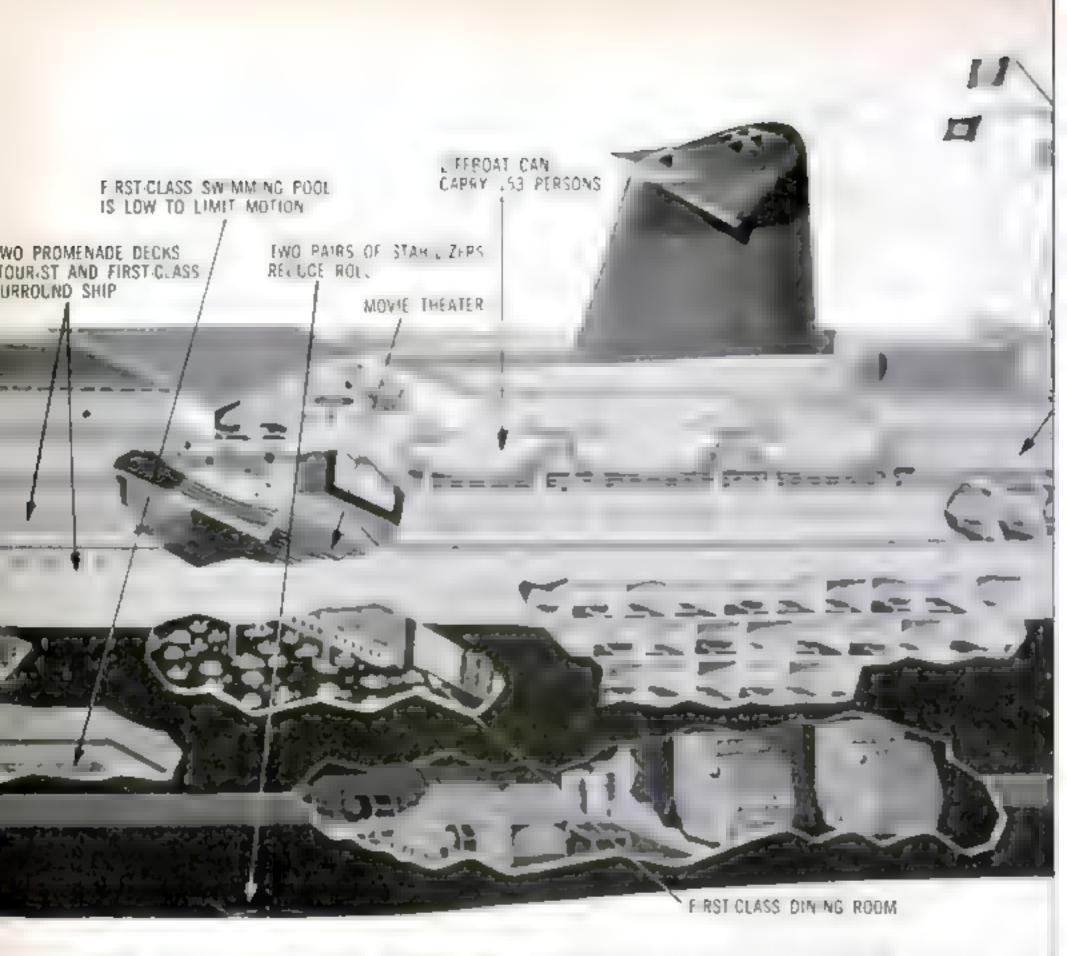
When it comes to speed, the French Line is close-lipped. It admits the ship will do 31 knots at 120,000 hp.-about what the United States averages—with a probable top of 150,000 hp. and 34 knots.

Nobody knows how fast the United

States can go because she has never been asked to do her best. She can produce around 158,000 hp, and she snatched the blue ribbon from the Queen Mary in 1952 by averaging 35.59 knots (about 41 m.p.h.) eastbound across the Atlantic, and 34.51 westbound.

The Queens haven't tried to beat that; so, if there's to be a new champ soon, it may have to be the France

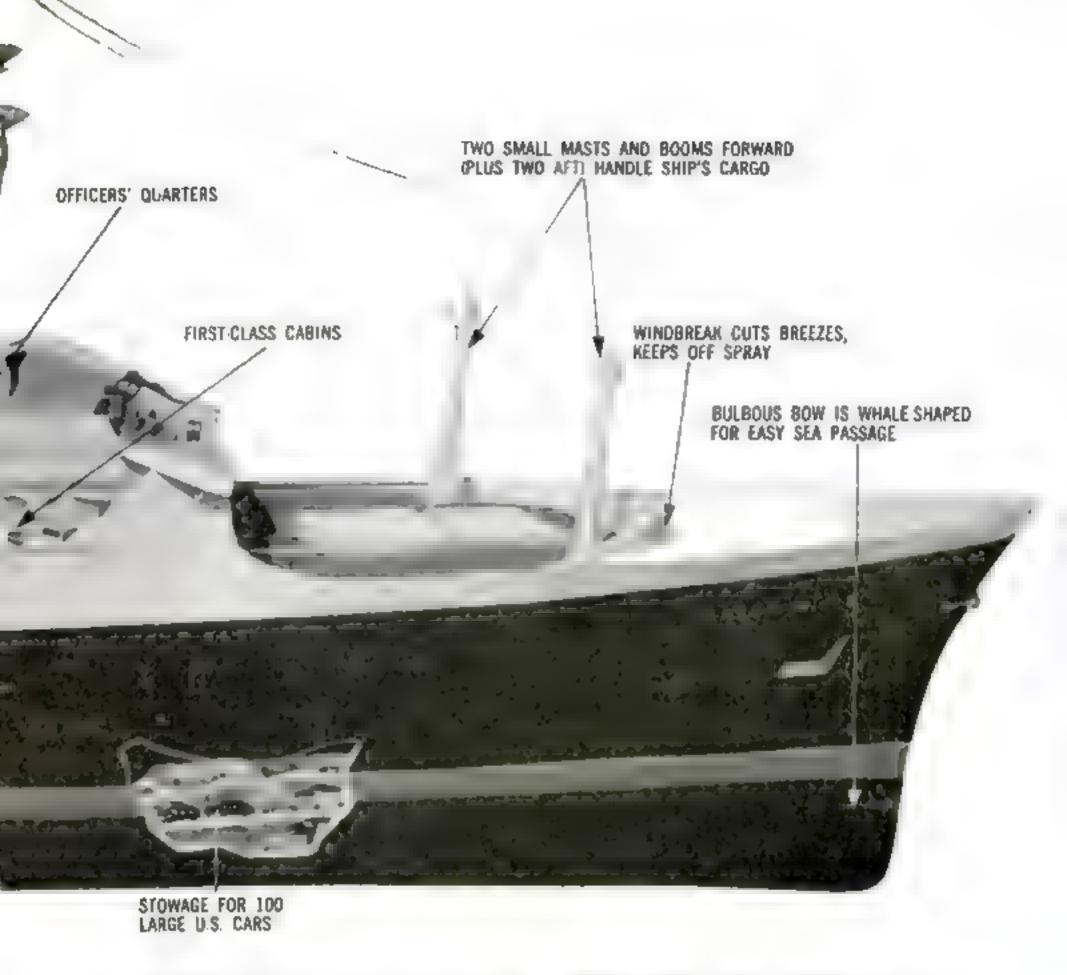
There's something exciting about a speed race. And ocean travelers eat it up. Also, there's a \$7,000 silver-and-gilt trophy, now aboard the United States It consists of two figures supporting a globe on which are two more figures, one holding a liner and one trying to snatch it away.



bigger boiler, More Power: Technical improveracilly give I rince same power as the Normandie on 10 percent less fuel, eight boders instead of 25. Note rider atop the buge boiler.

45-TON GEAR: Workman stands beside one of four reduction gears one for each peopeller shaft. If will turn 165 tunes a immite. Intal weight of ships machinery: 8,000 tons.





ON THE WAYS: View is from how, two years after keel was laid. Highest deck shown is the first-class promenade. Space beneath it will be occupied by one of the ship's theaters.

PREFABRICATION SPEEDS BUILDING: The tip of the bow, a 27-ton section, is swung into place. This delicate job was completed in 17 minutes by 10 skilled workmen and four cranes.





Concrete ties get main-line tests

TWO A MINUTE is the rate prestressed ties come out of this machine. They are then cured for 14 hours.

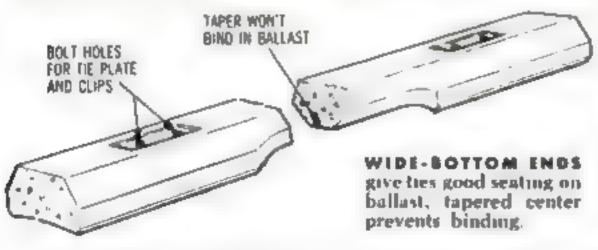
Concrete crossties are undergoing tests on quarter-mile sections of two railroads, the Seaboard Airline at Tampa, Fla., and the Atlantic Coast Line at Four Oaks, N. C. Concrete ties have been in use for years in Europe where equipment is relatively light. These new ones are prestressed, and were designed by the Association of American Railroads especially for this country's heavy trains. They are made at the rate of two a minute in a machine built by the American Concrete

Crosstie Corp. of Tampa. The machine is expected soon to double that output.

Rubber pallets, or forms, go through the machine on roller belts. They stop momentarily at points where (1) four stranded cables are fed in automatically and put under 20,500-pound tension. (2) the mix is dumped in, and (3) it is shaken down on a vibrator. Then the ties are set aside to cure for 14 hours.

Prestressed-concrete ties cost more than wooden ones: \$9 apiece against

\$4 50. But fewer are used—2,000 per mile against 3,000—and the hardware is cheaper. In addition, they are expected to last 50 to 60 years while the average life of wood is half that. Side advantage: They're spaced at 30 inches instead of 20—a more natural stride for hoboes and trackwalkers.



"Spaceman's" return

A Project Mercury manned-satellite test capsule is shown at right in a drop from an altitude of 30,000 feet into the Salton Sea off Westmorland, Calif. It was one of 35 test drops for the National Aeronautics and Space Administration at altitudes of 2,500 to 30,000 feet. All were successful, Two full-scale capsules, each weighing a ton, were used alternately, being dropped at high altitudes from an Air Force C-130 and at low altitudes from a Marine HR2S-1 helicopter.

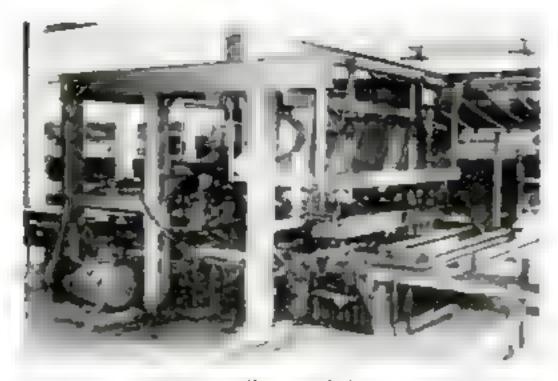
When a man is actually put into space, the capsule he travels in will descend in much the same way. It will automatically trigger its returning parachute at an alti-

tude of 45,000 feet



Out of the blue into the drink.

PS PICTURE NEWS



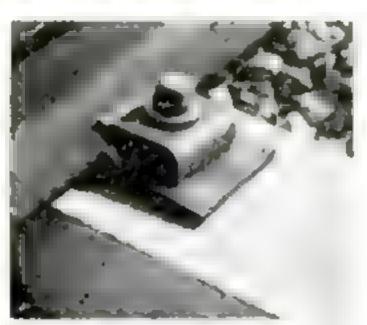
INSIDE THE MACHINE: Pallets (right) are put through on rollers, fitted with stressed cables, filled from the hopper at center, and then moved onto a vibrator.

STRESSING DEVICE at right pushes cable through pallet automatically, puts it under 20.500 pounds of tension.

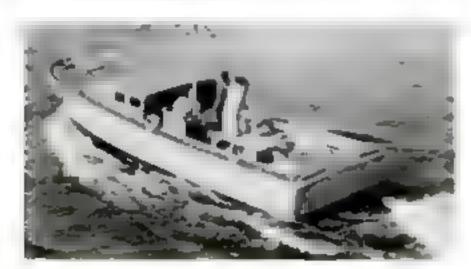




TIES ARE LAID in the same way that the old wooden ones were, and by the same track crews and equipment.

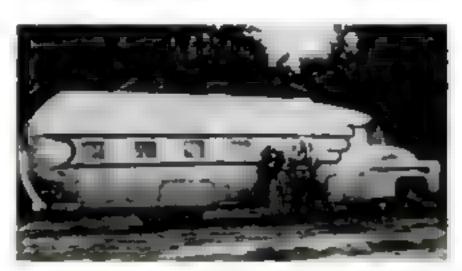


SPECIAL CLIP instead of spike holds plate to rail on each side. Two bolts are run through nuts set in recess at bottom of holes in the tic.



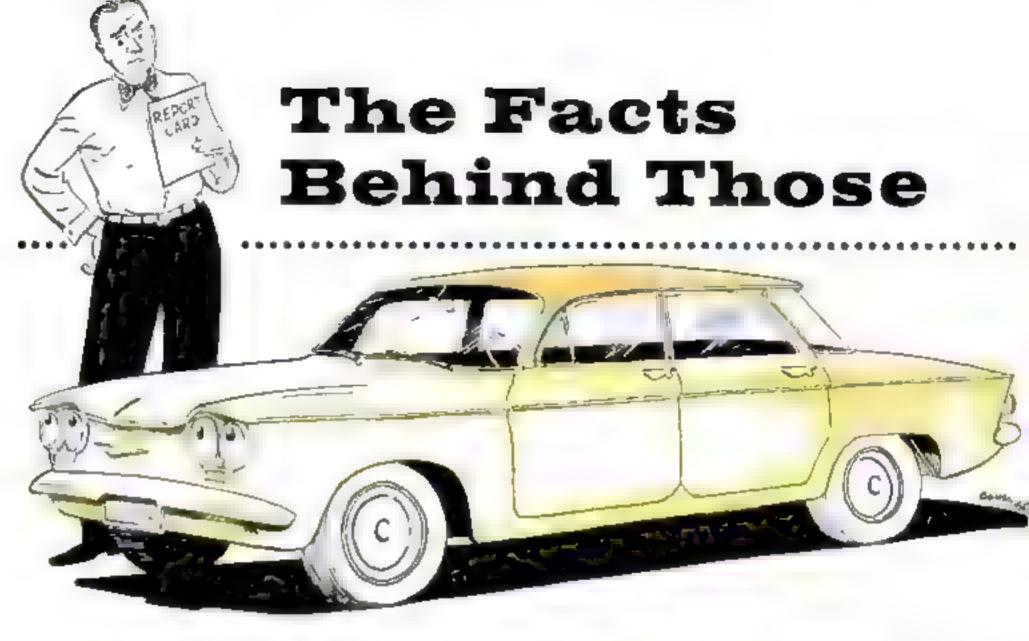
Gas-turbine mine sweeper

Navy mine-sweeping launches in Japan run on Boeing 220-hp, gas turbines. They are designed for close inshore maneuvering. In actual use, this one would have a second turbine mounted up forward to supply power for mine-sweeping gear.



Fuselage mobile home

This grounded DC-3 solved a housing problem Down Under. It's a traveling home for Jeff Carter, Australian author, on jaunts for story material. He mounted the fuselage on a truck chassis and renovated the inside for family living.



Behind the rumors is a dramatic sequence of technical troubles and crash-program fixes. Here's the inside on what happened

Detroit car in decades went on sale. Quickly the Corvair became a magnet for public attention. Whenever one was left at the curb, curious strangers would hoist the engine-compartment lid to gaze at the unusual aluminum engine in the rear and at the oddly sinuous fan belt. Everywhere early Corvair owners were met by curiosity and questions.

But some weeks later the situation changed. Tales about the Corvair began to circulate on the great American grape-vine. In gas stations and barbershops, talk ran that Corvairs were plagued by mechanical bugs. Those odd fan belts were reportedly breaking; the car stalled during warm-up and occasionally quit cold on the road; its heater gave trouble; and gas mileage was often disappointing.

Motor City security. In midwinter, Popular Science told me to get to the bottom of these rumors. This was not, as those who know Detroit can testify, an easy assignment. The official doctrine there, where millions of dollars can hang on public attitudes toward the product, has always been that the new model was perfect on introduction, and has been getting perfecter ever since. Aside from

the fact that no one from the lowliest engineer to the most awesome member of the brass enjoys admitting a mistake, there is also the credo in the industry that "you don't get fired for keeping your mouth shut."

It has been possible, however, to collect some answers. As of now (early spring), the following four-point summary checks out:

1. Corvairs built before December 7 the date of resumed manufacture after the steel-strike shutdown—did have a considerable number of bugs.

Though many were minor, at least two were real headaches that didn't respond to the first fix.

 Discounting the minor running changes that all makers put through on the basis of service analysis, Corvair's chief troubles have been under control since December.

4. Despite Chevy's fast action in remedying the bugs, last fall's troubles were serious enough to afford at least a partial explanation of why Falcon has been whaling the tar out of Corvair in sales.

The sinuous belt. Reports of fan-belt breakage—which, in a blower-cooled engine, hangs up the car almost on the spot

Corvair Stories

-began turning up immediately after announcement. (The belt broke on PS's test car at 2,500 miles, seven days after purchase, as reported in our January issue.) Corvair people are close mouthed about how widespread the belt troubles were. But when this magazine's test car stopped in Detroit in mid-October, on its way back from a transcontinental round trip, Chevy boss Ed Cole was wearily familiar with the problem. It was then thought to be a matter of incorrect tensioning.

As it turned out, it wasn't. During November, a number of technical bulletins flowed out from Detroit to Corvair dealers. (Such bulletins are, in themselves, nothing new—they're s.o.p. after the introduction of a new model.) One bulletin detailed the tension theory and elaborated on how to set the belt just right. It also advised very careful measurement of belt length; they'd found that if a belt was slightly short, though within previous limits, the adjustable idler would be in a position where the belt might rub destructively on a stud.

Then on November 23 an important bulletin went out to all Corvair shops. It announced that a new deep-groove idler pulley, a belt it inches longer than before, and a bolt to replace the stud, had been put on the production lines about November 3. The bulletin ordered dealers to install new pulleys and belts on all earlier Corvairs that came into the shop.

The background. Working in a crash program in October, engineers made strobe studies of the way the belt tracked on the production cars. First they found that inadequate tension was fatal, but that high tension cut belt life. Then they discovered that under certain conditions enough slack or waver could appear on the belt as it approached the idler to make bad trouble. The "cogs"—serrations—on the underside of the belt could catch on the pulley flange. This brought rapid fraying, and could lead to destruc-



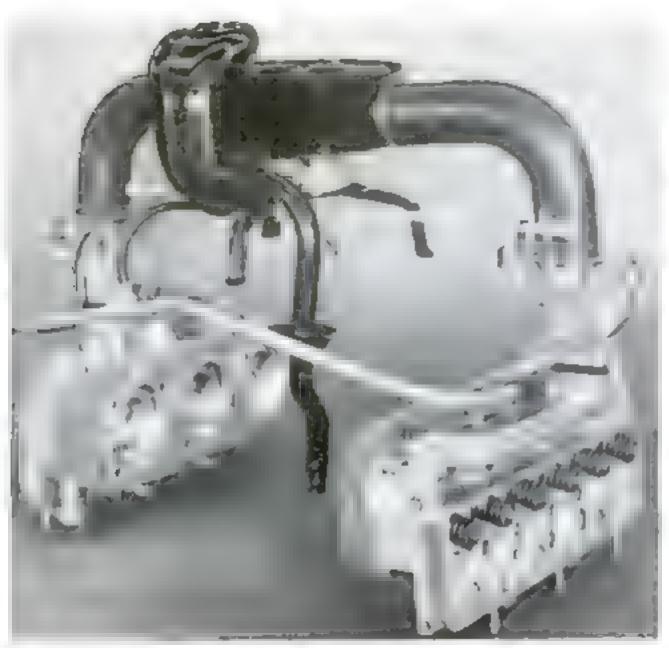
FRAYED BELTS on the Corvair's unconventional blower drive were the first headache. Typically, the belt didn't break but frazzled (as above) and then jumped off the idler pulley.





THE FIX was a deep-grooved idler pulley (above), unlike the original one (left) where the belt ran high up in the groove. In earlier version, combination of a half-turn in the belt, plus a waver in tracking in some conditions, caused the "cogs" under the belt to catch on the pulley rim, causing quick belt failure.

"Corvair isn't the first car to have bugs," said one



NEW INDUCTION SYSTEM has a different air scoop with warm-air pipe from under shroud. Earlier, plastic spacers under carbs are shown here.



summer. WINTER valve on hot-air pipe prevents power loss in summer. Chevy pays cost of three modifications, even on cars beyond warranty coverage. These are the carb fix, the new belt pulley, and the new one-stroke parking brake.

tive side-running, or to jumping off the pulley.

The new pulley evidently took care of the problem. It is noteworthy, however, that more recently Corvair has gone from a cogged to a plain belt. The change is officially for increased belt life, though it must also help keep an improperly slack

belt tracking right.

Those icy carbs. Late in October, when PS's test Corvair was racking up miles in New England and Canada, it suffered intermittent engine troubles [see January PS, page 211]. The problem was perplexing because it was self-healing. It was finally identified as carburetor ice, forming at brisk speeds in cool, humid weather. Trouble range was 32 to 42 degrees, with humidity above 75 percent. Ice formed in the venturis of the carburetors. building up around the cruciform jets in the throats and choking the engine. (What made it self-healing was that, with the engine stopped, enough heat would rise through the carbs to loosen the rime ice.)

A phone call in late October from this magazine to Detroit confirmed that Corvair engineers knew all about it. "With aluminum instead of iron," an engineer confided, "we're not getting the manifold-heat characteristics that we're used to. We're going to put through a fix on it—bleed a little warm air from under the shroud, to kick up inlet temperatures about 10 degrees."

This fix—a new air scoop with a summer-winter valve and warm-air feeders -was put on all Corvairs built after December 7. Fix kits for existing cars started out to dealers on December 16 and the bulletin on it went out December 28. One reason for the delay was the distracting discovery that the icing problem was actually two-pronged. Aside from the rime ice at the venturis, ice sometimes also formed on the throttles. Typically this ice appeared during engine warm-up on a cold morning; symptoms included persistent stalling even on fast idle, and high gas consumption from the choking effect.

engineer, "and it won't be the last one, either"

Tests indicated that the new air scoop didn't reliably lick this. So a second icing fix went out: replacement of the Bakelite heat-isolating spacer between carburetor and manifold with an aluminum spacer. The high heat-conductivity of the new spacer is tempered with an asbestos gasket. For too much carburetor heat is as bad as too little; it not only cuts power but also produces rejuctant warmweather starting, when gasoline percolates in the carburetor. So Corvair engineers had to move cautiously. They figure that the two fixes have licked icing

at the cost of maybe a second or two in increased average starting time for hot restarts.

The gas-fired heater. When cold weather apread over the country last fall, complaints about Corvair's combustion heater piled into Detroit. Some were about the way it worked, and a change in circuitry and a new relay were put on the production line. Other complaints centered on noisy operation at idle. Engineers found that annoying resonances could be reduced if two holes were drilled in the heater exhaust pipe at certain locations. bulletin describing

how to do it was sent out to all dealers. The two-stroke parking brake. The first Corvairs came fitted with a tricky parking brake; it took two or three pumping strokes of the ratcheting handle to snug the brake cables up tight. Field reports indicated that a lot of owners didn't understand it, expecting the brake to hold with a single tug. Others complained of the crash under the dash when it was released. Worse, there were reports of jammed or inoperative mechanisms. So a new, single-stroke assembly, modified from the one in the Chevy halfton truck, was put on the line. Another bulletin went out to dealers, ordering them to change over the brake on every early Corvair that came into the shop,

Other bugs. Sifting field reports last fall, Corvair engineers found plenty of little problems to sweat over. One was the occasional car that displayed unwonted torpor during acceleration. For these the fix, as dealers were duly told, was to disassemble the carburetors and file a careful .020-inch groove in a strategic spot. In a few high-mileage cars it was found that ends of the valves sometimes were faster than they should. A new push-rod guide that corrected it was put on the line, and released for dealer use during major overhauls.

A taste for gasoline? Though not strictly a mechanical bug, mediocre gas mileage was a recurrent theme in many field reports. Some aggrieved owners told of getting only 14 or 15 miles to the gallon, Even allowing for fuel used in the combustion heater and for the fuel penalty of an automatic transmission, such mileages were disappointingly beiow compact-car expectations.

Chevy engineers take the position that these cases were almost always a by-product of icing troubles. Said one: "It was as if the choke were closed. When ice builds

up in a venturi, you run on much too rich a mixture. What was wicked about it was that mild icing would often occur without being noticed—and she'd gulp fuel."

Outside engineers, while not disputing this, raise other questions about Corvair efficiency. They point out that Corvair runs at a slightly lower compression ratio (8:1) than Valiant (8.5:1) and Falcon (8.7:1). They note that the engine wants exact ignition timing for best mileage. And they observe that the offset position of the carbs on the intake manifolds might call for running a mixture that is a touch rich, to avoid starving the farthest cylinders.

Corvair fuel mileage got a staunch

it Could Happen to Anyone

Detroiters chuckle over one aspect of Corvair's troubles. The story goes that Ed Cole, big boss at Chevrolet. father of the Corvair. and a Mover & Shaker on the upper slopes of General Motors, was unexpectedly late getting in one morning. It seems that his Corvair had iced up on the way in. A few days after, when Cole was late again, the worst was realized: His fan belt had broken.

[Continued on page 217]



COMPLICATED WIRING SETUP is revealed by Sundra as he up-ends chassis of automatic dialer to complete soldering a connection.

REVOLVING DRUM can store the numbers of up to 50 seconty houses, keeps disling until it breaks through the feminine chatter barrier.

Gadget dials phone automatically

When Vinod Sundra, a senior at M.I.T. from New Delhi, got busy signals while phoning his girl friend at a college dormitory, he did something about it. He not only invented this automatic dialer, but also wrote a thesis on it for his B.A. in electrical engineering

The instrument consists of a plastic

drum wired to a series of conductors and insulators arranged to put in the call every 20 seconds. It also distinguishes between a busy signal and a ring, and sounds a gong when the connection is made. The drum can store up to 50 numbers, has a selector switch to pick out the right hot number.



Underwater drill

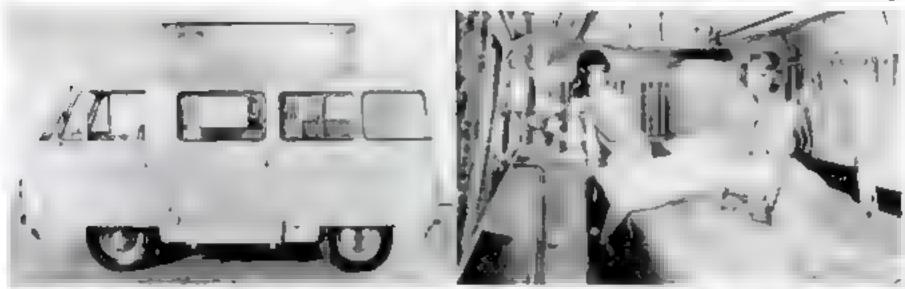
Air bubbles rise from this Thor pneumatic drill as it bores holes for steel rods that will reinforce a cofferdam under the water at Les Cedres, Quebec. The steel-and-concrete cofferdam is needed to repair draft tubes in a power station.



This is for the birds

Latest thing for bird fanciers in the Netherlands is this perambulator. It's for strolling in the air with canaries, parakeets, or other feathered pets—not babies. The Dutch manufacturer prices the bird cage on wheels at about \$43.

PS PICTURE NEWS



Accordion-pleated top lifts for extra height.

When opened, bed is wide enough for two,

Truck of many bodies

The new British Commer \(^4\)-ton truck comes with a choice of 14 different bodies. One shown here is a two-berth rolling home with an extendable roof for six feet of head room. When the top is raised, a pleated plastic curtain fills the opening. Seats can face front or rear, or the interior can be arranged as a dinette, lounge, bedroom, or for just sitting Other bodies include a 4-berth home, 12-seat bus, 8-seat station wagon, delivery and furniture vans, pickup, mobile shop, and an ambulance.

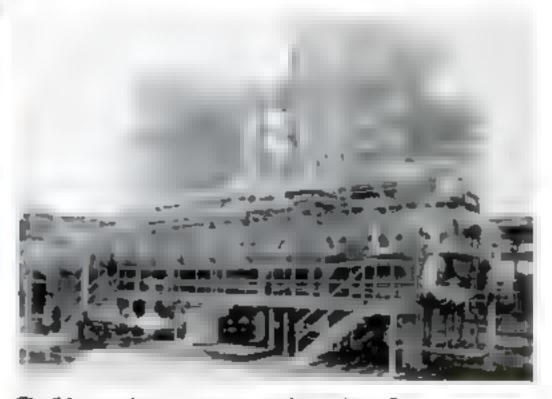


Basic chassis has Hillman Minx engine, gearhox, front suspension, and rear axle.



That grinding noise

A tiny radio transmitter is shown here built into a set of dentures. It picks up tooth contact and sends a signal that is amplified and recorded on a counting device. Col. Allen Brewer, a dentist, developed it at the Aviation Medical School at Brooks Air Force Base, Texas. He says the results indicate why some people wear out their dentures faster than others.



Salt-water converter tank

The 70-foot-long, 40-ton tank in front of the Southern California Edison Co.'s new Oxnard power plant above converts 100,000 gallons of sea water into fresh water each day for use in generating steam. The converter and plant cost \$250,000, will be the subject of an intensive three-year experimental program. The evaporator works in 26 stages, flashing salt water into vapor at varying pressures and collecting fresh condensation at each stage. It is said to be the largest unit of its kind in the world and is the first operated in connection with a steam-electric plant.



Airborne Cop Runs Traffic by Radio

BEFORE FLIGHT, Pilot DeVise (left) and Lt. Mehring plot course on a map of Cincinnati.



HELICOPTER IS READY TO GO as Art Mehring, the flying traffic cop, drives onto Lunken Airport

runway in a police cruiser. He makes two daily flights, during early and late rush hours.



WHIRLING DOWN OHIO RIVER, copter heads for Cincinnati's center. Bridges cause many jams.

FOR two hours each weekday a roving traffic cop, Lt. Art Mehring, is Cincinnati's favorite radio commentator. His beat is the whole city and he covers it in a helicopter. Most of the audience tunes him in on car radios—it's rush hour and they're headed to or from work.

By 7:45 a.m., Mehring is whirling several hundred feet over a main traffic artery. Station WLW interrupts a disk-jockey program to put him on the air.

"Somebody in trouble on Columbia Parkway," he will say, "Some of you people had better take Eastern Avenue instead."

Immediately, lines of cars begin turning onto Eastern Avenue. A few times the lieutenant has had the copter set down near an accident so he could unsnarl the resulting traffic jam on the spot

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HOVERING OVER A TROUBLE SPOT, only a few hundred feet up, gives pilot and radio cop this

broad view of roads and parking lots through the lower section of the helicopter's blister.

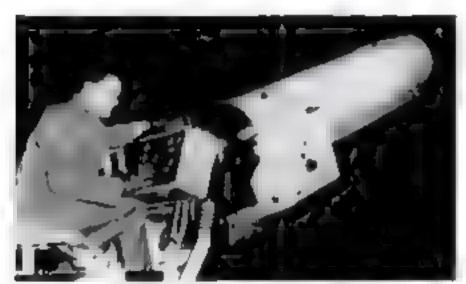


ON THE AIR: Every 10 minutes Mehring (above) gives a brief report. In WLW studio (right), producer Walt Rehbaum fits reports into disk-jockey programs.





Image of a skier is projected on the side of a snow-covered mountain.



It looks like a cannon, but shoots pictures.

Biggest projector

The cannon-like object at left is a Skyjector, a machine that can magnify an image 72 million times and project it against clouds or mountains five miles away. In the operator's seat is Michael Schwabacher, the Swiss owner.

From the back of a truck, Skyjector can shoot an image anywhere. Its cold-gas light source produces 92-million candlepower—equal to 80 giant searchlights. Unexcelled Chemical Corp., New York, hopes to rent the machine to advertisers,

Duplicating a roll-over

This machine duplicates the action of a car rolling over in a crash. It helps Cornell Aeronautical Laboratory study the impact on passengers in a side or endover-end roll.

The simulator consists of a standard 1956 body mounted between turn-tables that rotate at controlled rates. A camera (right) records motion of dummy occupant during tests.



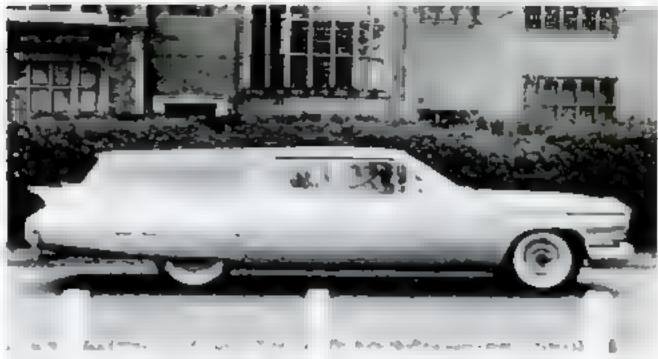
Caddywagon hits the highways

If your dream has been for a Cadillac station wagon, they are available now custom-built.

The body of this one, the first to be made, was designed by Peter C. I. Stengel of Hollywood and built by a century-old British coach firm for proud ownership by Max Hess, Allentown, Pa

It has a trunk much deeper than most—115 cubic feet of cargo space with the rear seat folded, 76 cubic feet with its back up as in the photo at right—and will carry six passengers comfortably.

The only changes necessary in the standard Cadillac chassis on which it was built were shifting the fuel-filler inlet from center to right fender and relight fender and rebumper to allow for the deep tailgate.



DESPITE LONG PROFILE, the station wagon is no longer than the conventional Cadillac sedan—225 inches from bumper to bumper.



INTERIOR FINISH is of wood-grain Formics with rubber luggage rubbing strips. Spare is in crescent container, tools ahead.



Bathtub rides on whee's

The man in the bathtub at left is Jaap Swart, a garage owner in Wormerveer. Holland.

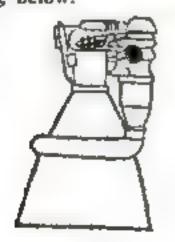
He equipped his vehicle with the rear wheel, sprocket, and engine from a motorcycle. Gravity feeds gas from an oilcan fuel tank. He steers with the two small rear wheels. Exhaust is diverted from cramped leg room by pipes poking through the sides. Faucets are pure whimsy.



PLUG NOZZLE has already appeared experimentally on Air Force's Hound Dog missile, designed

to be founched by B-52 bombers. Plug adapts turbojet engine to varying altitude.

super-rocker with plug-nozzle engine, shown in silhouette above, could be sent to moon on photo musion. Conical bottom contrasts in shape with the familiar bell nozzle, shown in smaller drawing below.



New Nozzle Gives Rockets

ITCHING a "plug nozzle" to the business end of a rocket engine may help to put the U. S. ahead in the race to explore interplanetary space. Four big manufacturers are working on the idea with an eye on our forthcoming giant Saturn rocket, designed to tote tons of payload out of this world.

The new nozzle, a cone-shaped piece of hardware, would replace the familiar bell-shaped nozzle used on practically all of today's rockets. From a ring-shaped throat around a plug nozzle's thick end, the engine's blast of burning gases streams rearward along its outside—instead of issuing from a bell nozzle's inside.

Surprisingly, surrounding air confines the hot jet to a narrow stream. Like water flowing down a pitcher's outside, it clings to the outer surface of the cone. So a plug nozzle, able in that way to discharge exhaust gases at higher velocity, gives better thrust in air. That's its big advantage—but not its only one.

To steer a rocket, a bell-nozzle engine swivels in gimbals. A plug-nozzle engine can be rigidly fastened to the rocket frame, saving weight and space. You simply arrange a number of individual combustion chambers around the exhaust throat in a compact cluster—and regulate them separately to vary thrust for steering.

Overall length of a plug-nozzle engine, studies indicate, will be half that of designs now in use and projected.

The plug idea for reaction engines goes back to World War II, when the Germans experimented with it. A plug has been used experimentally on the turbojet engine of the Air Force's Hound Dog missile, for maximum thrust at varying altitudes. Now big-rocket designers, seeking more

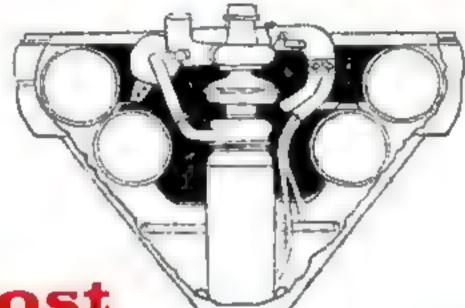


EXHAUST STREAM of rocket, clinging to outside of plug nozzle on its way toward point of cone, is shown above in atmosphere (left) and in



space (right). Self-adjusting flow, to suit changing altitude and air density, approaches the effect of an ideal "variable-size nozzle-

INSIDE OF PLUG, engineers suggest, could be put to use to house miscellaneous auxiliary equipment of the rocket engine. Fuel lines would cool the plug.



Bigger Boost

powerful engines, find it a likely answer to their problems. Like an automobile engine, a rocket engine does its work with expanding gases. In an automobile, the gases push down the pistons to turn the crankshaft. In a rocket, ejecting the gases rearward gives the vehicle a forward push or thrust. The higher the velocity of the rocket's exhaust, the greater the thrust.

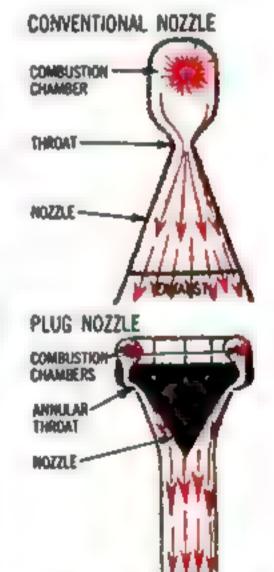
So in the vacuum of space, where there's nothing to get in the way of the exhaust, a rocket's thrust is greatest. The thrust is less in air, where a rocket begins its climb, because the atmosphere's back pressure hinders and slows

the escape of the exhaust stream.

That's just where a plug nozzle shines, by comparison with a bell nozzle—in low-altitude efficiency. And as a rocket ascends, a plug nozzle's flow is self-adjusting to suit more-rarefied air, approaching the rocket designer's ideal of a "variable-size nozzle."

One reason plugs haven't yet been sent into space is that the art of big rocketry is new. To cautious designers, so far, building a bigger rocket has meant scaling-up an existing design. But the next step upward in size may bring the plug-nozzle innovation. It may show up in at least one stage of the multistage Saturn. Experts say the new nozzle is particularly suited for a big rocket's initial or booster stage.

Trials already are well under way. Aerojet-General has made 1,500 test-firings of plug-nozzle models. General Electric is testing a 20,000-pound-thrust version. Rocketdyne has run a modified Atlas engine with a plug at up to 40,000 pounds' thrust. And Pratt & Whitney, plug-nozzle turbojet pioneer, is investigating rocket uses, too .- Devon Francis.



SHORT LENGTH of plug nozzle saves space. Design with multiple combustion chambers is compared above with a conventional, twice-uslong beil nozzle.

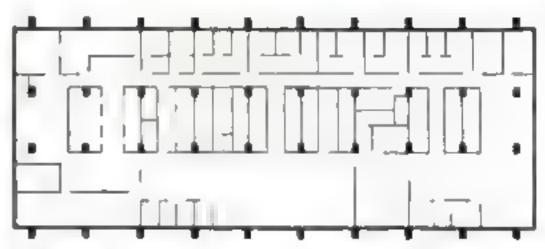
PS PICTURE NEWS



GIANT STEEL FRAME of the new 60story Chase Manhattan Bank towers 825 feet above street level.



EXTERIOR COLUMNS above thirtieth floor are insulated to halt movement caused by extreme temperature changes.



Columns in center only leave more usable floor space.

Extra room inside big office building

The sixth tallest skyscraper ever built, the 60-story Chase Manhattan Bank building is shown here during construction. Its 900-foot tower—uniform from the fifth basement to the top—is the highest constructed without setback

The building, in New York City's Wall St. financial area, contains the largest gross area within its walls of any structure completed in the last 25 years, This is made possible by the use of 20 exterior columns, leaving only two rows of 20 more, encompassing elevator shafts, to break into usable floor space.

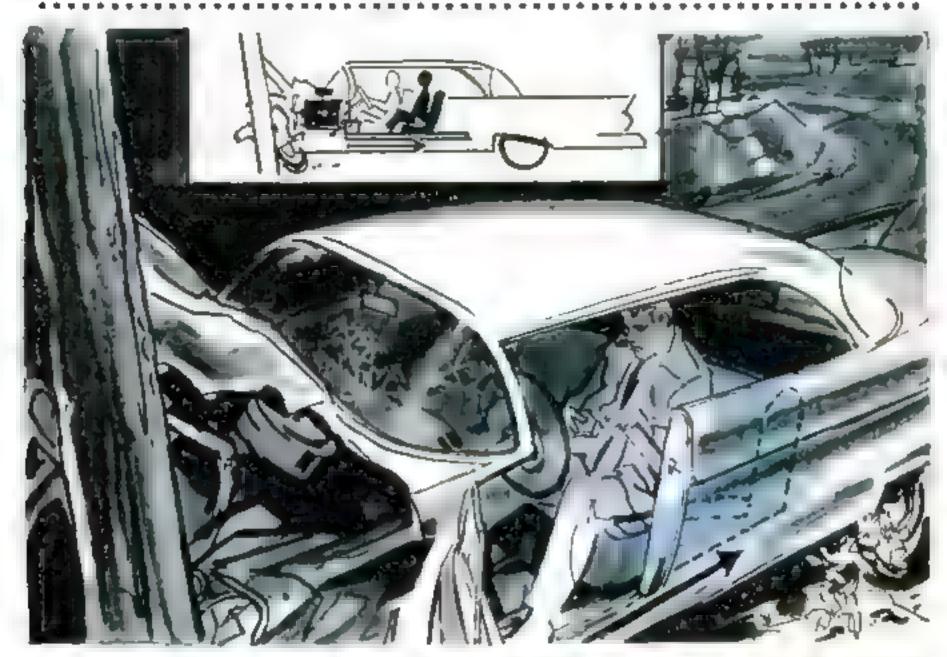
A total of 53,000 tons of fabricated structural steel-exceeded only by that in the RCA and Empire State buildings was used in its construction.



Kart rack for

Makers of one of the new little speed cars have designed a carrying rack for use on an auto. On this Thunderbird, six suction cups hold the front of Century Speed Kart's carrier to the roof: the back is bolted to the tire rack.

New Ideas from the Inventors



Crash Seat Slides with Engine. You might have a better chance of surviving in a crash if you were belted to this recently patented car seat. It would be

mounted on rails shared by the engine; any impact that dislodged the engine would push the seat back an equal distance, reducing chance of injury.

Level Bubbles Light Up. With a miniature bulb and battery illuminating the bubble tubes of this spirit level, working in dim areas would be simplified. Magnet inserts in the base would permit no-hand attachment to pipes, and the light would make the bubbles visible at a distance. Piano Signals Next Note. Feeding a suitably punched sheet into this keyboard trainer would cause the corresponding keys to light up in playing order. Lights focused upward at each translucent key would be blocked out except where perforations let the beam through.





9

More Inventors' Ideas



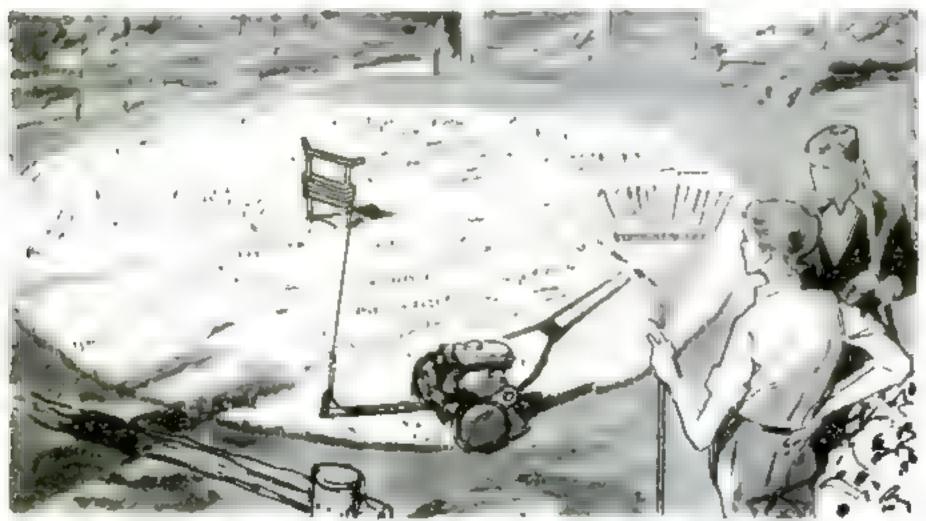


Car Pen for a Baby. Narrowing at the top to conform to the backward slope of a car's front seat, this combination crib and play pen would provide a safe standing space for a traveling baby plus a wider sleeping area in the base. It would fold compactly when not in use.

ages sealed with a metallic tape could be loaded quickly and easily by a cranedriven electromagnet. The magnetic lift would eliminate damage from hooks or tongs. The tape could be a sandwich of iron filings between adhesive strips.

Pivot Guides Power Mower. Your lawn—or at least a large, circular part of it—might mow itself if you attached this ignition cut-off to your mower and tied it

to a reel around which it could pivot. A spring in the line would adjust for slight tugs, but when the line was fully wound the cut-off switch would kill the engine.





Float Adjusts Sinker Depth. After dropping—or casting—a line fitted with this float, you'd just give a tug to raise or lower the hook. Slots in a rubber-walled cylinder inside the float would grip the line when you pulled in one direction, free it when you switched direction.

Tray Eases Car-Snack Service. You wouldn't have to juggle your car-stop lunches if your glove-compartment door were equipped with this service tray. A hinged panel that extended toward the driver's side would increase the table area, and cut-outs in the base would keep cups from sliding or slopping when the car was parked on an incline.





Machine Speeds Bottle Returns. At least one waiting line might be shortened if a supermarket installed this bottle-return machine in its parking lot, You'd slip bottles into sized openings. The machine would calculate the refund, issue a slip, and move the bottles inside on a belt.

The following potents have been tissued on these incentiones. Cook sent No. 2,900,036 to N. J. Brake, Chicago, Level-No. 2,900,036 to U. J. Brake, Chicago, Level-No. 2,900,036 to U. J. Merchant. Licevind Heights, Ohio, Car pen-No. 1,834,031 to F. N. Johansen, Silver Spring, Md., Metal tape-No. 2,97,370 to R. A. Bennett, N.I.C., Mower pivol-No. 2,796,944 to 4. T. Crement, Jr., Clarksburg, Md., Float-No. 2,789,861 to R. D. Hudson Linckburg, Va.; Car tray-No. 2,789,861 to R. D. Hudson Linckburg, Va.; Car tray-No. 2,789,861 to R. D. Hudson Linckburg, Va.; Copies of patents may be ordered, by number, from the Commissioner of Potents Danksguon 2. D. C., at 25 cents each To write to an insentor of the wilder as given obtain insufficient, you may address him is. name and patent number) in case of the Commissioner of the North that the Commissioner of the Commiss



for a base price of \$14,895 at the dock. Its silky aluminum V-8 has everything but the vulgarity of a horsepower rating.



World's Fussiest Car Factory

Weekly output at Rolls-Royce is in the dozens—and no wonder.

These cars are fondled into being, released only grudgingly

By David Scott

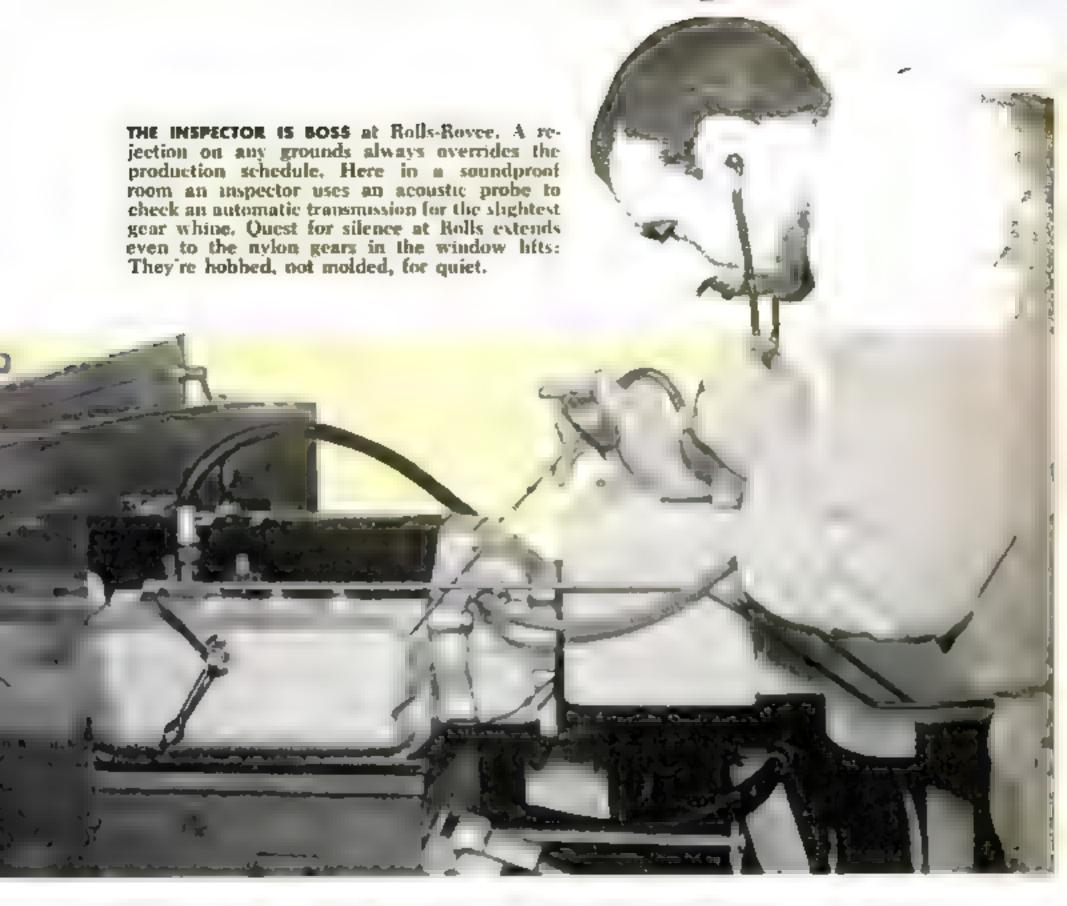
HEN they took me through the Rolls-Royce plant at Crewe, in central England, one engineer observed: "The day we start building a car like Cadillac, Chrysler, or Lincoln, we

will have no right to charge any more for it than they do." At this strange factory, production costs are disregarded as a matter of policy. No customer is ever promised a firm delivery date—because no one can predict when the Rolls inspectors will release a car for sale.

NO LOCK NUTS OR LOCK WASHERS are tolerated. Instead, connecting-rod bolts are tightened to a gauged stretch. Each bolt is "waisted" to take the strain area away from usual failure points at threads. R-R makes its own bolts, to control steel quality, and neces cadmium-plates the threads, since slight extra friction might give false torque readings.

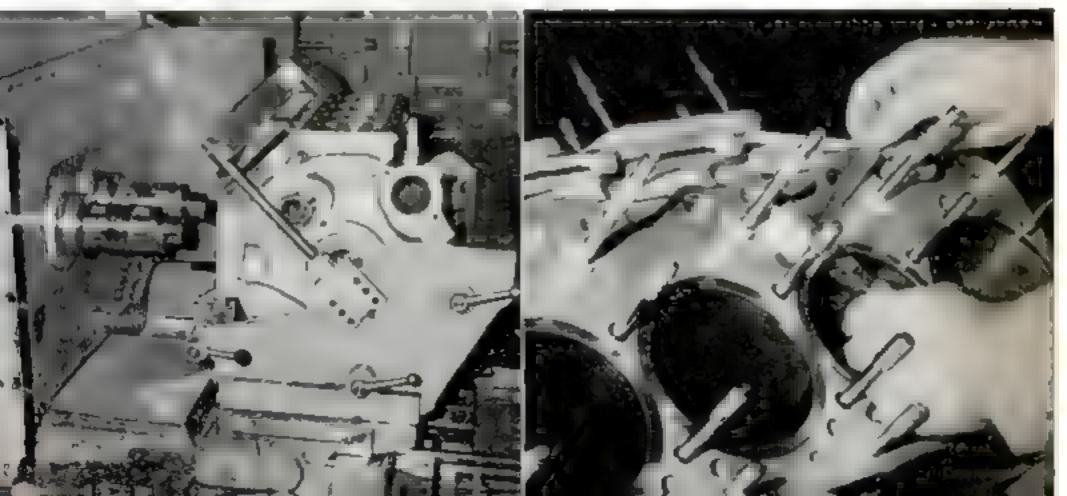
cast-iron cylinder liners are honed on a standard machine—but with a difference. Instead of using an automatic stop that cuts off the hone when the correct average diameter is reached, the operator runs machine manually. Every few strokes he gauges the liner at top, middle, and bottom. Then he adjusts the stroke so that the liner comes to exact diameter all over.





complex tooling bores the aluminum V-8 block for the wet cylinder liners. Each of the two spindles has no less than 11 tools to finish the main bores, cut three grooves for scaling rings, and bore a recess for the liner flange. Costly tooling is not for high production, but to perform all related operations in a single pass, insuring concentricity and squareness.

cylinder liners, inserted in the block, are checked with a thickness gauge under a flat bar held across the top. Each liner must protrude just .002 inch above the block before the cylinder head is tightened down. Lower end of liner must be free to expand because east-iron liner and aluminum block expand at different rates. (Please turn the page.)

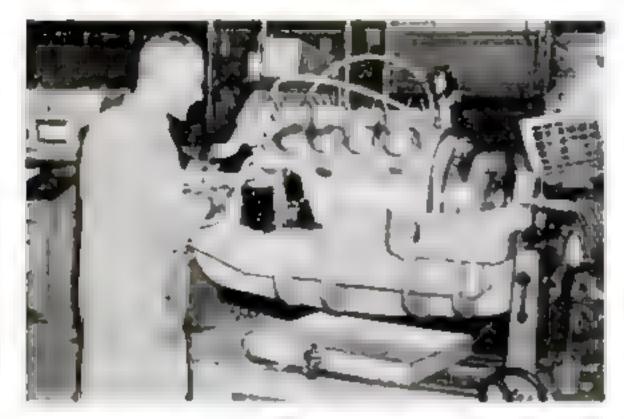






MUD-SPATTERED CHASSIS has just returned to Rolls-Royce tactory from test run on nearby country lanes. Circular object at side of transmission is a shipping-clotch servo that gives proportional power braking. Rolls uses two separate master cylinders and separate piping, for maximum safety in case one braking system develops a leak—plus a mechanical parking brake.

TWO ELECTRIC FUEL PUMPS, in timelers but independent level the carborators. They are a counted outside frame so the taint ticking noise won't reach passengers' ears, and are radio-suppressed and fitted with a splash guard. Rolls follows a 'belt-and-suspenders' duplication policy, which also accounts for the separate three braking systems and the quartet of V belts.



EVERY V-8 ENGINE is halanced as an assembly. It is placed in this fixture, with heads off, and spun by an electric motor. Electronic transducers not only show any imbalance, but report if it is nearer the front or the rear of engine. At the front, the operator makes corrections as shown here, drilling through guide holes into the crankshaft vibration damper. If balancing is needed at the rear of engine. there are compensating weights. graded down to half a gram. that can be fastened at the right spot on the starter ring gear



POUR-SHOE FRONT BRAKES are fitted to one model, the high-performance Bentley Continental. The drams are three by 11½ inches. Each pair of quadrant sectors pivots on a common carrier and is actuated by its own cylinder. Special friction clamps on each shoe minimize clearance when hydraulic pressure is released, making the brakes self-adjusting for shoe wear.



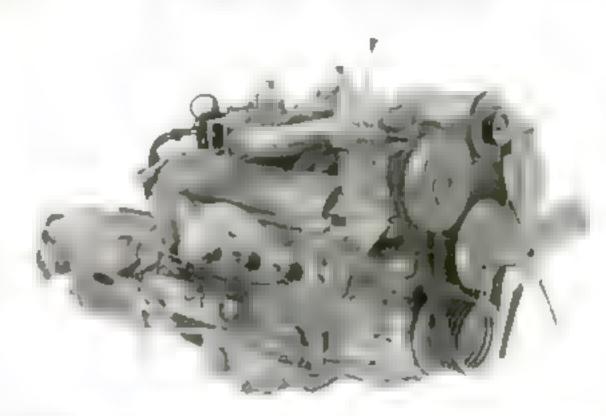
THE HARD WAY to get ribbed cooling fins on the cast-iron brake drums is to machine them from the solid like this. It would be much faster and cheaper to east the fins. But Rolls feels that there just might be blowholes in cast fins, from the faster cooling of thin sections. So the company prefers to machine the fins, even at 15 minutes per drum.



HYDRAULIC COUPLING in transmission is first given a static balancing. Then it is filled with oil and apun at speed to analyze its dynamic balance. Small balancing weights are welded on us needed until all vibration is canceled. In the transmission valve housing of the Rolls, many machining tolerances are as low as .00025 inch—a quarter of a thousandth.

DYNAMIC BALANCING of crankshafts isn't unusual in auto industry—but not like this. Circular weights, matched to within a quarter of a gram, are bolted to each crankpin. Each corresponds to the weight of the two con rods and pistons that are paired on each pin. Then shaft is spun and metal on heavy side removed. It takes about two hours per shaft.

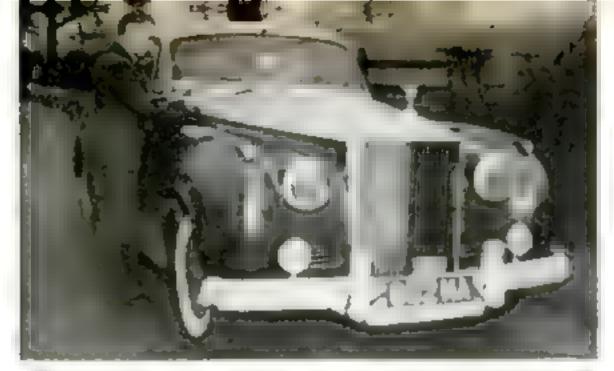
POWER IS SECRET, but it is enough," in Rolls' own word, to push the 4,650-pound ear through brisk acceleration to a 110-m p.h. top. Displacement is 380 cubic inches. Design details include dual S.U. carbs, dual distributor points, dual belts on each auxiliary drive, and a dvnamically balanced magnetic clutch for the air-conditioner compressor. Bolls' obsessive quest for silence is reflected in hydraulie valve lifters, unequally spaced fan blades, and location of the oil pump at extreme front-as far from passenger compartment as possible.





AN ODD "MILKING MACHINE" helps achieve a squeak-free mating of body and chassis. First, two hydraulic rams pull body down to normal loaded height. Then pneumatic clamps, set to exert a 50-pound pull, are hooked to body support arms and mounting pads, idea is to get a precisely uniform sharing of the load among mounting pads before bolts are tightened.

FAMED ROLLS RADIATOR, made of burnished stamless with mitered joints, is soldered together by skilled tinsmiths. Each shell takes nine to 10 man-hours. Top and front surfaces look dead that but are actually a few thousandths convex, so they will look flat. The company says this is in accordance with design principles learned from the ancient Greeks.



TEST SUPERINTENDENT Dong Fox takes a virgin Rolls on the normal 200-mile shakedown cruise. Soon his check sheet is marked up: a hint of wind noise that calls for resetting one rear door, slight stiffness in the accelerator kickdown, a faint squeak. Each item is turned over to a specialist for fixing.



EVEN SUBAUDIBLE WHINE in differential means the unit must be stripped and gauged. Sileneing by adding shims, common elsewhere, is not tolerated.

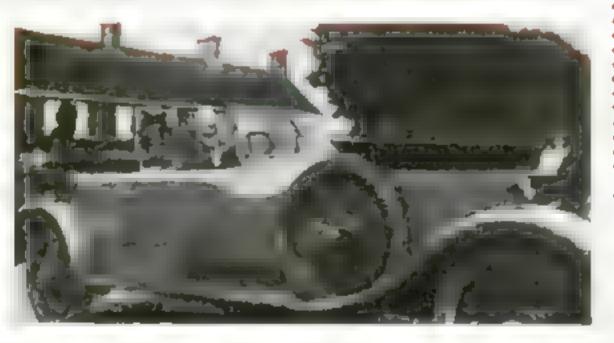


NO-NANDS STABILITY at 110 mp.h. on a country-road straightaway is demonstrated by tester Doug Fox-to this reporter's alarm. Even at this speed, you can talk in normal conversational tones. Each new Rolls-Royce spends at least a week in final testing and tuning up.



SLAVE SODIES are temporarily installed on finished chassis intended for outside coach-builders. Purpose is to permit extensive road-testing under normal load conditions. (Weighted box at rear simulates trunk.) Some deluxe hodies can add \$8,000 extra to the price.

Sir Henry Royce began building his cars in 1904, working "with the holy zeal of a . barefoot pilgrim"



"IN DIFFERENT circumstances he might have led a religious revival or qualified as one of the more formidable saints." That is how a biographer once described Sir Henry Royce. Although baffled by engineering theory, Royce was a magnificent craftsman. Working freehand, he could file brass to a perfect hexagon for

a hubcap. Obsessed by perfection, Royce was never satisfied: left to himself his car would probably never have gone into production, It was salesman Charles Rolls who supplied the commercial drive that made the costly car world-famous.

Rovce, who died in 1933, is shown above in a 1925 Phantom I Rolls-Royce.



Papoose carrier

Footsore junior hikers will welcome this restful British chair.

A tubular-steel frame for the fiber-glass seat is strapped to mom's or dad's back like a knapsack. The base forms a footrest.



Mortarless lock

Thin nylon disks hold these new Swedish building blocks in place instead of mortar. Only three are required for each bond. The blocks are three feet long and grooved on opposite sides to take the 1½-inch-diameter wafers. The first course is laid in mortar on a normal foundation.



Lift with built-in twist

This big lift truck not only picks up a 13%-ton load but can swing it 90 degrees while holding it 18 feet off the ground. It can grip a diameter of five feet, was built by Hyster Co., Portland, Ore, to handle concrete piling for a bridge in Venezuela. Here it manages a steel casing filled with steel rods.



Ski plane adds JATO

A combination of jet-assist takeoff and skis enables heavy Hercules C-130s to deliver supplies in quantity to outposts in Antarctica as long as seven months of the year. With it the big Lockheed proppets land on and take off from bare ice and snow instead of being confined to ice runways, which can be safely used only two months of the year. This eliminates the need for parachuting—with possible breakage—of delicate instruments to isolated "Deep Freeze" scientists.

Telescopes in Space to Probe Secrets

Outposts above the earth's air have opened to astronomers a golden new era of discovery

By Alden P. Armagnac

A 36-INCH mirror of quartz may solve the riddle of whether there's life on Mars—and what kind. The big disk will go into a camera-fitted, radio-controlled, TV-monitored reflecting telescope being built at Norwalk, Conn. An enormous unmanned Stratoscope balloon will carry it on 20-mile-high flights, due to begin in the summer of 1961, to photograph the moon, the planets, and certain "radio stars." A prime objective: to get the most revealing pictures of the Red Planet ever made.

Observatories in balloons, rockets, and ratellites will make the Sixties memor-

able for astronomers. For the first time, they're viewing the heavens from above the earth's atmosphere. They call it the biggest advance since the invention of the telescope.

From astronomy's beginning, observers have scanned the skies as from the bottom of a murky sea—the turbulent atmosphere. Because of its light-refracting eddies, the stars twinkle; watchers at powerful telescopes get only rare glimpses of faint details like Mars' "canals"; and Mount Palomar's huge 200-inch reflector usually attains only 1/20 of the resolving power, or useful magnification, that it has in theory.

Not even mountain-top observatories are high enough to escape a major region of air turbulence, at the 40,000-foot level of the jet stream and the stratosphere's floor. Carried higher, a relatively modest-sized spyglass could outdo

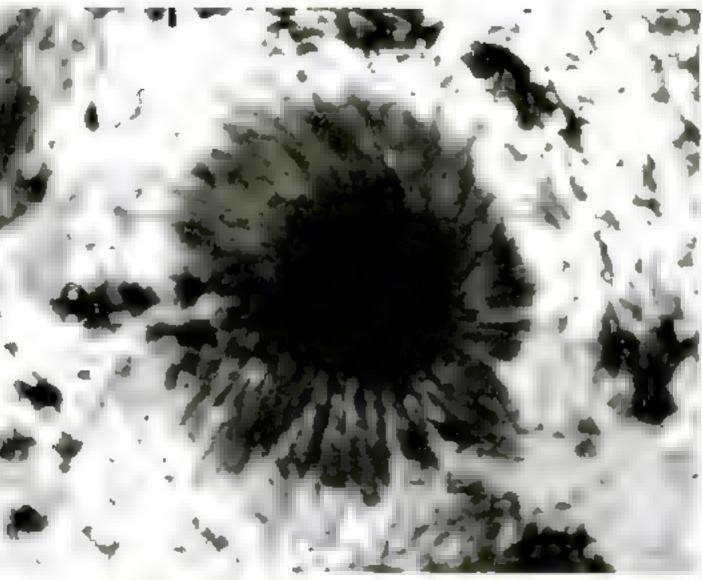


"MARS MIRROR," 36-meh disk of fused quartz, gets checkup after preliminary polishing at Perkin-Limer plant. It will be eye of hig telescope to view the planets from 20 miles above earth, in new Stratoscope balloon ascents due to begin in 1961.

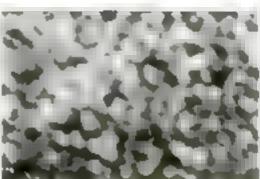


PROTOTYPE for new 'scope is this 12-inch one, shown in balloon-borne cradle for last year's Stratoscope flights.

of Universe



supers closs-up view of a sunspot, resembling giant eye, was made last year at 15-mile altitude by 12-inch telescope. Earlier Stratuscope photo of sun's face, right, showed details as small as 180 miles across. It revealed oatmeal-like complexion of unexpected pattern. Whitish dots are rising columns of incandescent gas.



SENEATH BIG BALLOON, a Stratoscope observatory starts aloft, as speeding truck tosses it free—a new "dynamic-launching" procedure that works in wind, keeps payload from being dragged along ground.



control van and antermas on ground aim 15-mile-high telescope by radio command. TV camera aloft lets astronomers, at receivers in van, watch what remote-control telescope sees.

Above-the-air observatories in rockets, and in satellites





FIRST PHOTO of sun's disk by far-ultraviolet light, which never reaches earth, was made from rocket 123 miles high. It shows solar atmosphere at height exceeding 4,000 miles.

NOVEL CAMERA designed at Naval Research Laboratory, mounted in nose of Aerobee-Hi rocket (left), made ultraviolet photo of sun above with exposure of 1/50 of a second.

the biggest earthbound telescopes—and that's the dream now coming true.

Sensational photographs of the sun, the clearest ever made, show what outposts in the stratosphere can do. The pictures are the first fruits of history-making "Project Stratoscope" balloon flights, conducted in 1957 and 1959, and continuing next year. Under the direction of Prof. Martin Schwarzschild, Princeton University astronomer, the unmanned 1,000,000-cubic-foot balloons have been lifting a 12-inch telescope to an altitude of 15 miles—up where the deep-purple sky is almost black, above more than 96 percent of the world's air.

With a screaming noise heard hundreds of yards away, high-pressure helium gas spurts from the hose of a Navy tank truck to inflate the towering balloon, at an airport outside Minneapolis that serves as the launching site. As the 200-foot-high gas bag lifts and strains at its truck-mounted payload, the truck leaps forward, jockeys into position right under the balloon, and frees the packaged observatory. Within 90 minutes it's stratosphere-high and in business.

Only lately has this "balloon astronomy" become feasible—with the innovation of making balloons of paper-thin plastic, lightweight and strong, instead of the heavier rubberized fabric used before. Transparent and airy-looking, pear-shaped instead of round, the new gas bags come in unprecedented sizes—up to a fantastic 10,000,000 cubic feet, bigger than history's largest airship (7,000,000 cubic feet).

Manned or unmanned, they rise higher, and lift payloads to greater altitudes, than balloons ever did before. Exploiting the high-climbing craft for astronomy, Prof. Schwarzschild has devised novel observatories to hang beneath them.

His camera-fitted 12-inch telescope was entirely self-operating in two initial Stratoscope ascents sponsored in 1957 by the Office of Naval Research. Responding to photocells, electric motors swung and tilted the 9½-foot telescope barrel to keep it aimed at a preselected part of the sun's face, despite the balloon's motions. A special 35-mm. camera snapped a 1-by-1½-inch, 1/1,000-second exposure every second—8,000 frames in all. Then

to come, are exciting new gifts of Space Age to astronomy



SURPRISE DISCOVERY by rockets was sky region blazing with far-ultraviolet light around star Spica Comparison with size of sun and moon as viewed from earth, shows its vast extent

SPACE TELESCOPE of 50-meh size in mamanised saterlite, shown by model, now is projected for U. S. national observatory. It will view images electronically, radio them directly to earth.

the observatory, loosed from the expendable balloon, parachuted to earth for recovery of its precious film.

Prize trophy was history's best photo of the sun's oatmeal-like complexion—showing details as small as 180 miles across, and picturing the circulation of incandescent gases in the solar atmosphere. By revealing an unexpected pattern, it revises astronomers' ideas of what goes on in stars. It may also hold clues for harnessing H-power on earth—since the sun offers a look at a successful thermonuclear furnace in action.

In last year's improved system, astronomers on the ground aimed and focused the 15-mile-high telescope by radio command—the first successful remote control of an astronomical observatory high above the earth. Through a TV hookup, observers in a ground-control van watched what the telescope was seeing, and directed it to solar markings of special interest. Four ascents were jointly sponsored by ONR and the National Science Foundation. Magnificent photographs of sunspots resulted.

Next Stratoscope flights will use the

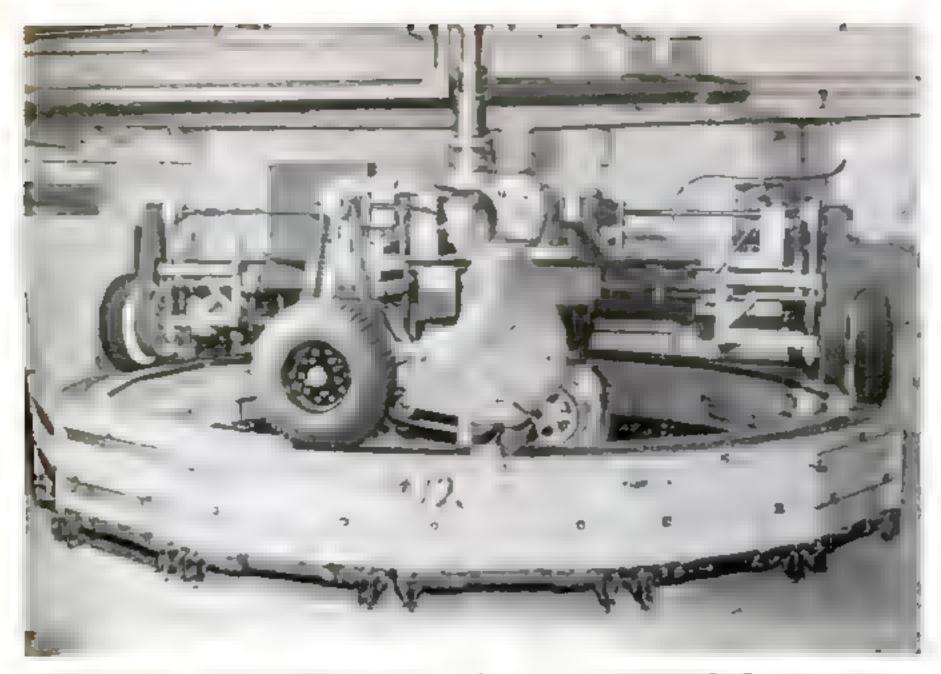


new 36-inch telescope. Its builder is the Perkin-Elmer Corp., maker of the earlier 12-incher. Trained on the "canals" of Mars, and the planet's blue-green regions of supposed vegetation, the big reflector should have an excellent chance of solving their mysteries. The exciting project now is triply backed by ONR. NSF, and the National Aeronautics and Space Administration

Manued balloons, too, are aiding astronomers. Last November a 2,000,000-cubic-foot ONR balloon lifted two men and a 15-inch telescope for a 15-mile-high look at the planet Venus, and the discovery of water vapor in its atmosphere—one essential for the existence of life, as we know it. That underscored another advantage of balloon astronomy. Water vapor and oxygen in the earth's air have hindered detecting them on other planets, by masking spectrograms' evidence. Rising above the air ends the difficulty.

Rockets are giving astronomers higher vantage points, at altitudes ranging from 60 miles—where the daytime sky becomes dark as night and the stars shine

[Continued on page 230]



Machine tests 16 types of road material at once

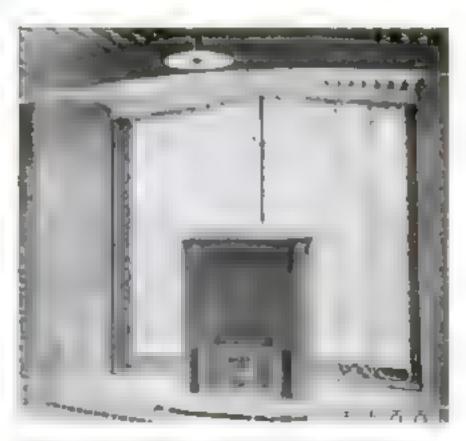
These four tires, revolving around a spindle, test new highway-paving formulas in Standard Oil's laboratories at Whiting, Ind. Asphalt laid on a foot-wide circular track 44 feet in circumference is

subjected to constant daily grinds under loads that can be varied from the weight of a bicycle to that of a heavy truck. With pavement laid in segments, 16 kinds of road can be tested at a time.



Roll-along tent

When the hinged lid of this boxlike trailer is propped up, a canvas flap is dropped down the other side to form a tent for motoring campers. The British unit can be set up in 16 seconds.



For captive congregations

Fretwork behind the altar in the chapel above is made of carbon steel. It's in the new prison at Lebanon, Ohio. The altar enclosed in a sound box has two sides for use by various faiths.



Nature's only flying mammal comes alive after dark—but seeing is no problem when he has a radar far superior to man's

By Joan Steen

B ATS are not blind. But many scorn to use their eyes. They have a built-in radar system instead—incredibly accurate and far superior to any invented by man. Which explains an age-old mystery; how buts get around in the dark.

They're spectacularly successful at finding it. They don't through black forests gobbling insects at the rate of 25 a minute. (The photo above shows them snatching bait in a lab.) They fish on moonless nights, seizing minnows hidden below the water's surface. Forest branches don't clip their wings; water scarcely touches their

toes. And after the night's bunt, they sign sag through dark caves, finding their rocats where no light ever shines.

The secret behind this earle skill was penetrated in 1935 when a Harvard senior, Donald Griffin, tested a cageful of buts with a new machine designed to record, insect songs. It clinched his theory:

Bats sound their way through the dark. They issue little chirping noises through their mouths or nostrile, then listen for the schoes that bounce back.

Before Griffin's experiment nobody had ever heard those chirps. They were pitched too high. Most bats make sounds at fre-

CONTINUED

Whispering, chirping, or clicking fine tunes, bats sound



TINY SAT with very long ears belongs to a species (Plecotus rafineaquii) that may be the most skillful of all sonar bats. Dodging the 0.025-inch wire on the right is a cinch for it.

quencies from two to 10 times higher than people can hear. Even low-voiced bats hit bottom at a pitch that tops the highest note on a piano (10 kilocycles compared with the piano's top of 4.186). The Harvard machine took the bats' ultrasonic chirps and made them audible.

Chirps are the heart of the bat's navigating system. It's really sonar because it uses sound waves, not radar (which uses radio waves), but the principle's the same: The bat clocks how long it takes waves he sends out to reach an object and then echo back

You may have used the same idea to judge how far off a storm was: You watch for the lightning, count seconds until you hear the thunderclap, then multiply by the speed of sound to get the distance

The amazing bat, with a brain smaller than that of a mouse, does all that and much, much more. You wait for sound to strike your ears; he generates his own—forcing echoes to be produced. While you stand still, he flies along at a 12-foot-a-second clip. You stop to calculate; the bat continues in the triple role of transmitter, receiver, and computer all at the same time

Clever? That's just the beginning. Look what the bat can do with his builtin sonar: Flying through trees at night, he can recognize instantly which echo comes from branches and which from a mosquito. He knows where the branches are and where the mosquito is. He never bumps a twig, but he gets the mosquito.

To test the navigation of bata, Dr. Griffin—now a world-renowned expert in animal sonar—strung a network of fine wires across a pitch-dark room. One type of bat can detect 0.12-inch wires at a distance of 85 inches. If the wires are only .007 inch in diameter (about twice as thick as human hair) he still recognizes them, but no farther than 35 inches away. Compare that with a man-made radar the Signal Corps is very proud of: It can detect an object the size of a man.

Such accuracy calls for ultrarefined measurements. But chirps are only a thousandth of a second in duration. They're timed like a metronome—beating 10 or 20 times a second if the but is flying a straight course. But if he's approaching an obstacle or homing in on a tasty tidbit, the but shaves each chirp even finer, and ups the rate to 250 chirps per second. (To do this the muscles in the but's larynx have to contract 250 times a second—a feat no one ever thought any mammal could manage.)

Now that investigators know what to listen for, they've occasionally heard bats make these sounds in flight. (They hear

their more detailed information over Echaes of Bats and Men for Bound R. to his flow Businessay Science Study Series



BATS' WINGS are really extensions of their hands: The "ribs" are fingers; the wings, skin.

their way through the dark

the faintly audible lower tones that some bats make.) But the tones are so brief they come over sounding like ticks. And when the bat accelerates them, the ticks crescendo into a steady buzzing noise.

The bat needs hairsplitting measurements. The more chirps he can make, the more detailed is his picture of the surroundings. But he has to be careful not to drown out weak incoming echoes with his strong outgoing chirps. Thus he makes each chirp as short as possible. The echoes then occur in the "long" silent times between

Why ultrasonic chirps? Once the bat chops his chirps to the briefest of intervals, he's forced to stick to ultra-high pitches. Only then are the waves short enough to fit into the time he allows. The longer wave lengths of lower pitches wouldn't have the time to extend themselves fully to the target and echo back. But high notes and short waves have even greater significance:

Bats are small animals that chase even smaller ones—insects usually. To get a decent echo, the bat prefers to hit his prey with wave lengths equal to it in size or smaller. Otherwise the sound, instead of reflecting nicely, would scatter

leaving no usable trace to pick up.

Any bat knows that. And a variety of other sound principles, too. Dr. Griffin believes the bat's pea-sized brain interprets not only the time lapse (to gauge distance), but reacts to subtler changes in the intensity, duration, and pitch of echoes as well.

Most bats have these skills, though they vary in their tuning patterns and flight maneuvers. Some are more talented than others.

artful dodgers of the lot are the little brown bats common to North America and Europe. The chirp they emit is a mixture of sounds. It starts out high and may swing down a full octave at the end. This change of pitch is frequency modulation—similar to the system used in FM radio—and gives these bats their nickname.

FM bats can catch one-seventh of their weight in insects in an average hour's hunt. One animal tested caught 175 mosquitoes in 15 minutes.



MYSTERIOUS "MISS X" hangs upside down and munches on a banana. She thoroughly charmed her owner who finally typed her as a fruit-eating (and seeing) but from Africa.

Second cousins of the FM bats are the minnow-lovers. Their sport may be the most challenging of all. Sound-detecting objects in air is tough enough. It's far more difficult when sound has to travel from air to water and back again. Each time it crosses from one medium to the other it gets 99.8 percent weaker.

Horseshoe bats. One variety of bats broadcasts on an almost constant note. Each note lasts longer, too—as long as

a tenth of a second.

This seems dull compared with FM bats, but nature has endowed the breed with compensating talents. Their name comes from a double series of folds and membranes around their nostrils. Like megaphones, these concentrate the sound into narrow beams. The bat flits through space pointing the beams now here, now there, scanning the horizon for strong echoes just the way man-made radar does.

Horseshoe bats presumably understand that when sound hits an object dead ahead it bounces back fast and strong, but if it returns from an object off to the side, it sounds weaker.

[Continued on page 236]

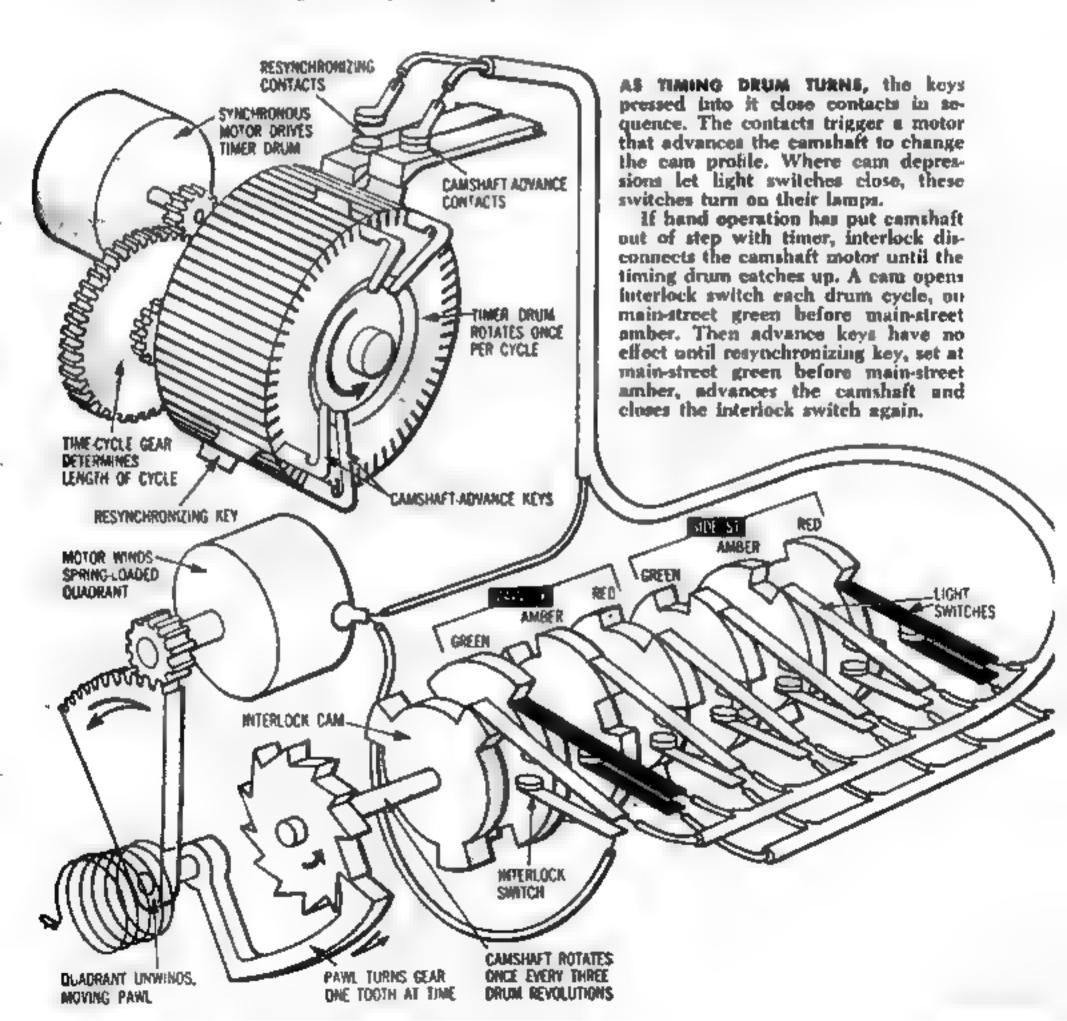
How a Traffic Signal Works

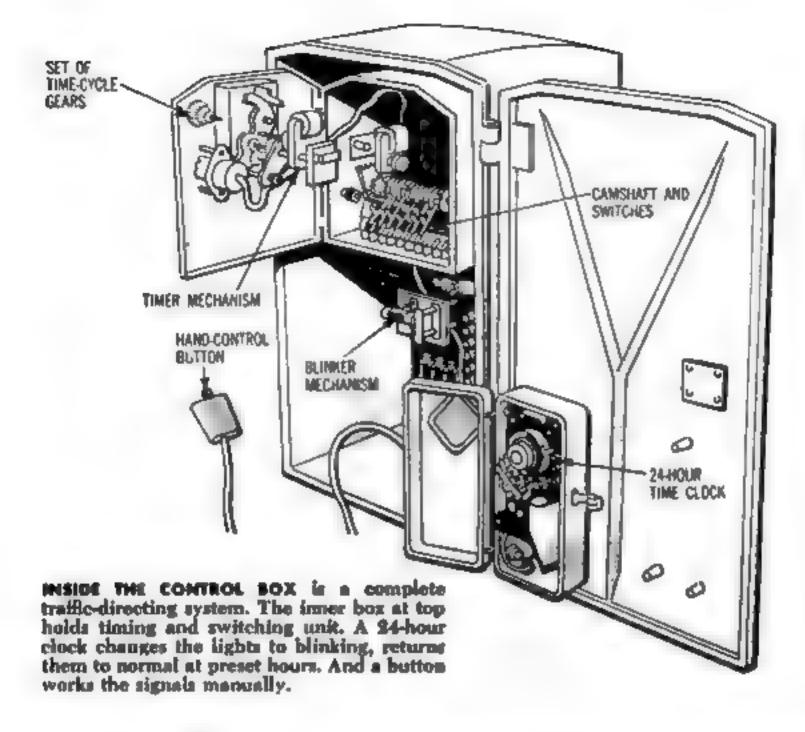
HOSE flashing automatons that monitor our traffic, preserving lives and fenders, cost roughly \$1,500 apiece. This adds up to a huge investment in large cities—New York operates \$40 million worth of such gear.

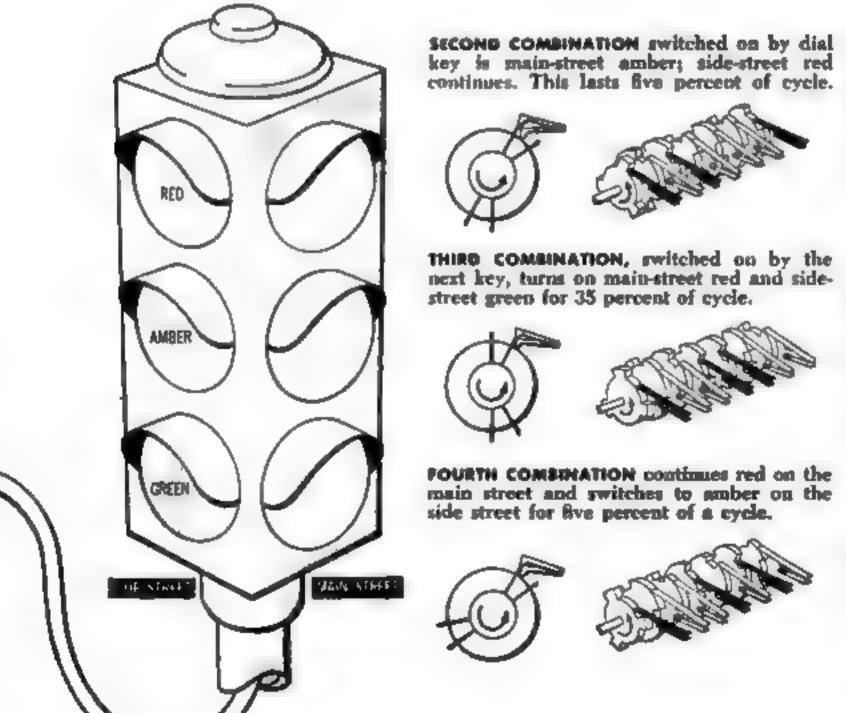
Traffic-light controllers like the M 20 Marbelite described here are remarkably versatile. They can be run manually or automatically and can follow orders from a distant point by cable or radio. A time clock can make lights blink at night, return to normal during the day. If a cop

mixes up the signals manually, controllers can straighten themselves out when they're switched back to automatic.

Inside the control box is a timer that works the light switches electrically, through a motor-driven camshaft. One timer-drum revolution changes lights for a complete signal cycle. Keys in four of the drum's 100 slots determine what percentage of a cycle each light will be "on." A choice of gears can vary cycle time from 50 to 90 seconds in 10-second steps.—Erik H. Arctander









Hushed power mowers, quiet outboards, even noiseless chain saws are all possible with-

The Silent Engine You Start with a Match

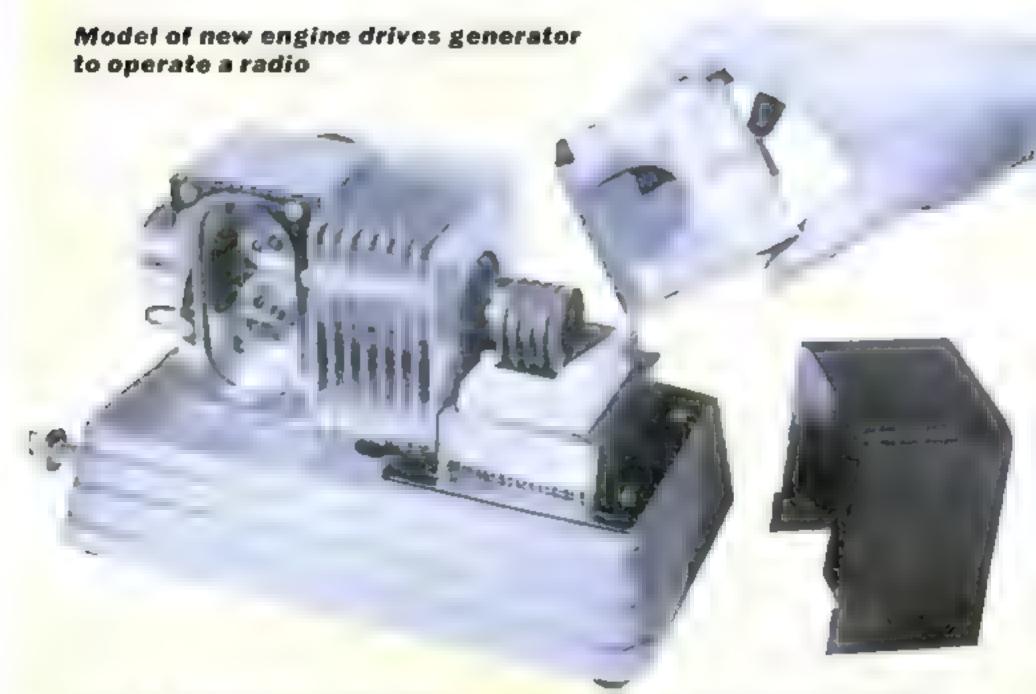


TABLE-TOP PHILIPS ENGINE above with new rhombic drive is fixed by a gas burner fed

from a separate propane tank. Removing the chimney exposes the finned heater.

By Harry Walton

A DIFFERENT kind of one-lung engine is headed your way. Some day you may get into a boat, put a match to a burner, twist the engine shaft over dead center, and glide silently out to catch the big ones.

That same engine could give us hushed power mowers, quiet-running home electric plants, and even muffled cement mixers or chain saws. But its first job may well be in outer space—to drive electric generators in orbit-

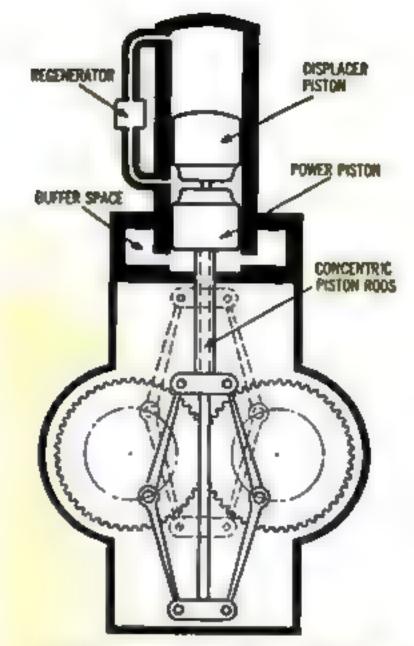
ing satellites.

It's the hot-air engine, updated by modern research and a gee-whiz conrod system like none you ever saw. This faithful old-timer now beats the diesel, the gasoline engine, even the gas turbine, in efficiency. In this jet age, it puts the piston engine back

in the running.

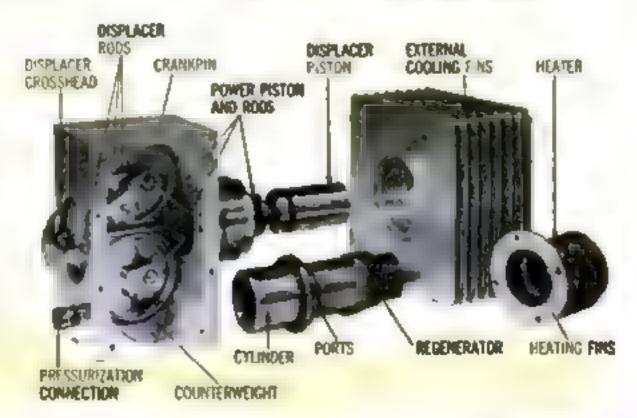
As tomorrow's outboard or mower engine, it ducks many griefs built into gasoline putt-putts. It has no carburetor, ignition, spark plug, or valves. Having no exhaust, it needs no muffler. Even in one-cylinder form, it is vibration-free. You can run it on gas, kerosene, fuel oil, or burning straw. It can be compact, delivering up to two horsepower per cubic inch of piston displacement.

Heat is the muscle power. A diesel



DISPLACER must lead the power piston by about 110 degrees to key the working cycle properly. This diagram of the rhombic drive shows how such crank displacement is achieved. The degree of displacement can be altered by changing spacing between the shafts, or by fitting offset links to the crankpins. Because the pistons work in tandem, the displacer rod must pass through the power piston. A buffer space keeps high working pressure out of the crankease, while maintaining it on the underside of the power piston. This lessens the work of the compression stroker compression ratio is only 2.5:1, far less than in a gasoline engine.

at right shows the rhombic drive with its twin crank-shafts. Fins inside the heater and cooler speed heat transfer. Working air flows from inside the cylinder through annular ports, passes over the outside of the cylinder past the internal cooler fins, through the wire regenerator, and picks up heat from heater fins as it returns to the top of the cylinder.



locomotive compresses a cylinderful of air while it is cool, introduces fuel, and sets it afire when the piston is at top dead center. The violently heated air expands, driving the piston down. That's internal combustion, but it's the expanding hot gases that do the work.

A Scottish minister named Robert Stirling got the idea of heating and cooling the air in a closed container, kept hot by an external fire at one end and cool by a water jacket at the other. His engine, invented in 1827, shoved the air from one space to the other by moving a loose-fitting piston. A second, close-fitting work piston was pushed in while the air was cool. Heated, the air expanded and drove this piston out.

The engine worked. But it was very heavy for the power it put out. It wasted fuel; the heat the air absorbed in expanding had to be thrown away to let it contract. Efficiency was about five percent.

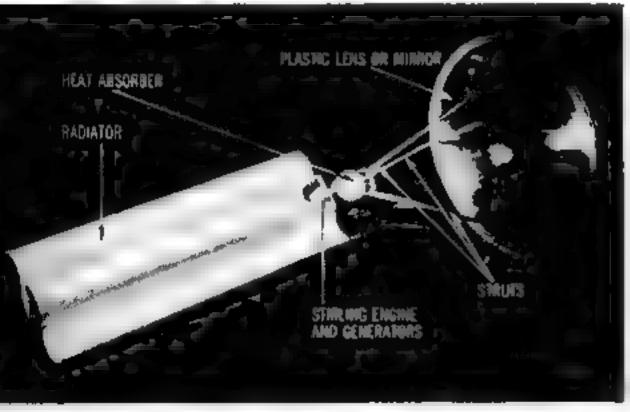
This inspired Stirling to add the regenerator, a chamber of fins through which the air passed between the hot and cold spaces. Coming from the hot space, it gave up heat to the fins. Returning from the cold, it took heat back from the fins.

Further improved by others, the hotair engine went to work in a powerhungry world.

John Ericsson, builder of the Civil War Monitor, developed what he called his "caloric" engine. It differed somewhat from Stirling's—the pressure of the air instead of its volume remained constant as the air passed in each direction through the regenerator. By 1833, he was deep in experiments with marine application.

Ericsson put a four-cylinder engine into a Navy vessel. Its 14-foot pistons developed 300 hp. Other Ericsson engines went into riverboats, Smaller ones pumped water, and tiny alcohol-fired ones turned fans. But with the development of the electric motor, steam and internal-combustion engines, Stirling's engine became a museum piece.

Wanted: power for generators. In 1938 the N. V. Philips Gloeilampenfabrieken, of Eindhoven, Holland, sought a means of generating electricity for radios and

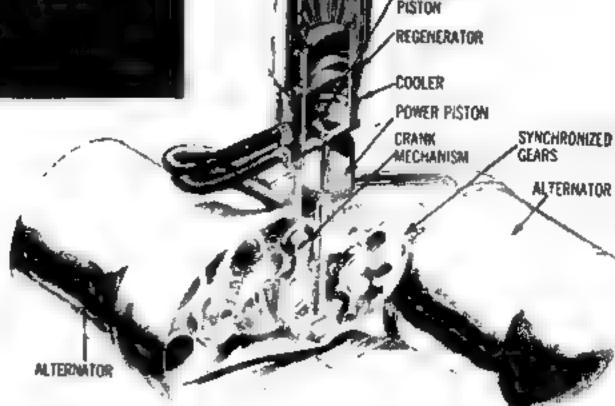


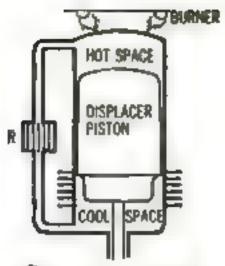
solar beat to run a Stirling hot-gas engine. Sun's rays, focused on a heat absorber, melt lithium hydride, which flows through engine's heater. Coolant from engine gives up its heat to radiator, which then disperses it into space.

HEATER

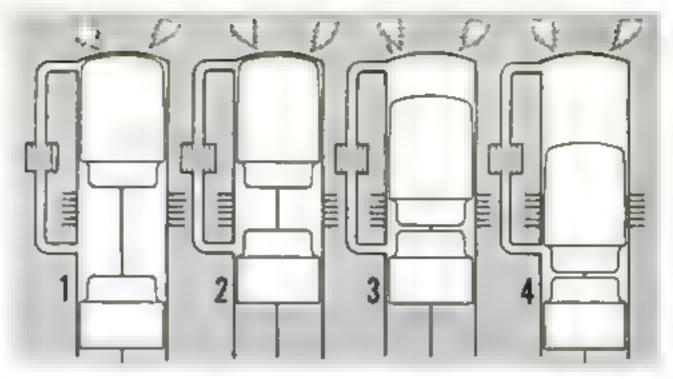
DISPLACER

ONE-CYLINDER Stirling engine, designed for satellite power plant (right) by Allison Division is coupled to two alternators. It will generate three kilowatts. Since all rotating parts are paired and turn in opposite directions, gyroscopic effects cancel out. Entire unit will be sealed in a belium atmosphere.





As the displacer piston moves up, it forces all the air out of the hot space, through the regenerator (R) into the cold space below, where it contracts. As the piston moves down, it reverses the flow, displacing all the air at the bottom and forcing it into the hot space, where it must expand.



Work RESULTS when the cylinder is lengthened and power piston added. With displacer at top, and the air in the cold space (1 above), power piston rises either by the starting turn or from flywheel momentum to position in 2, compressing the cool air. But now the displacer moves downward (3). Air entering the hot space expands, driving the power piston down. As displacer continues downward, the rest of the air is transferred, moving the power piston to the bottom of its stroke (4). The displacer now returns to position 1, repeating the cycle.

home lighting. The steam engine was too bulky, demanded too much attention. The gas engine was too choosy about fuel.

Philips dusted off the hot-air engine, applied modern knowledge of thermodynamics and heat transfer, and got an amazing answer: The hot-air engine had a theoretical efficiency of 71 percent, higher than that of diesel, gas engine, or turbine.

War and the Nazi occupation engulfed Philips. The canny Dutch hid research files, took names off lab doors to conceal what they were doing. In 1944 the first engine proved successful. By 1947 it was running moderately efficient generating plants. And by turning the Stirling cycle upside down, Philips created excellent refrigerating and air-liquefying machines.

But engine efficiency still lagged, until the researchers found that dead volume (the space not swept by the work piston) was critical, and that air wasn't the best working medium. Hydrogen, lightest of gases, would hold more B.T.U.s per pound, flow like a greased eel, take on and give up heat in a flash. Build an engine this way, they said, and it should have an actual efficiency of 36 percent.

In 1954 the engine was built. It checked out at 36 percent. Today's best aircraft piston engines are only 28 to 30 percent efficient. The diesel scores 32 to 34 percent; the gas turbine lags at 26 percent.

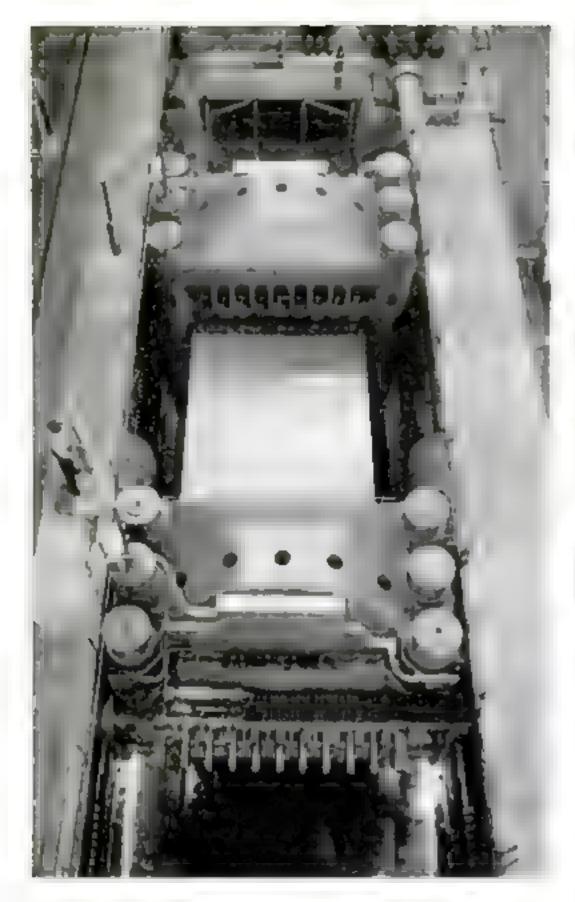
Updating the Stirling. What made the difference between the feeble old Stirling engine and this rugged new contender? Better materials, sophisticated heat-transfer surfaces, regenerators with 98-percent efficiency, and pressurization.

You can build an air engine that limps along on the air that seeps into it from the atmosphere. When hot, it will be slightly above atmospheric pressure; when cold, slightly below. Its power is what you might get if you moved a gasengine piston to top dead center, let air into the combustion chamber at atmospheric pressure, squirted in fuel, and managed to fire it.

Instead, your car engine gulps a cylinderful, then compresses the charge to a fraction of its original volume before firing it. The more air you jam in, the greater the pressure rise on firing. But in gas engines, compression is limited by the critical fuel-air ratio necessary, and by antiknock considerations.

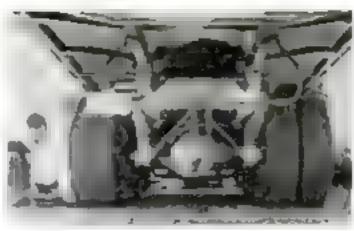
In the closed system of the externally fired hot-air engine these don't matter. The new Stirling engine works at an average pressure of 1,500 pounds per square inch, which can be maintained by a small pump. On expansion, pressure rises to 2,100 p.s.i.—not in an explosive bang, but in a smooth, steady push.

[Continued on page 240]



Massive plate stretcher

This big machine grips 60-foot lengths of aluminum six inches thick and stretches them as much as four feet. The device holds the ends of the plate in its two huge heads and, at the press of a button, exerts a pulling force of 30,000,000 pounds. It is installed in a concrete pit at Kaiser Aluminum's Ravenswood, W. Va., works.



One tire for two

A tire nearly twice as wide as conventional treads is being built to replace duals on the backs of trailers. Firestone, which put the 18,00-by-19,5 tire and rim on the truck above with a set of duals, says its load-carrying capacity exceeds that of two tires, it takes less space, and provides better cushioning for loads.



Waterless water test

A midget altitude chamber makes it possible to test waterproof watches without water.

It's a vacuum chamber designed by Bulova Watch Co. for jewelry stores and watch repairers. A watch coated with a detector solution is put in. When outside pressure becomes lower than that inside the watch, any leak is shown by bubbles.



Picasso style

Modern art influenced the design of this highway bridge at Wuppertal in West Germany. The structure rests on a single upright. Stresses are carried by the arch to the opposite embankment.

14 POPULAR SCIENCE MAY 1980



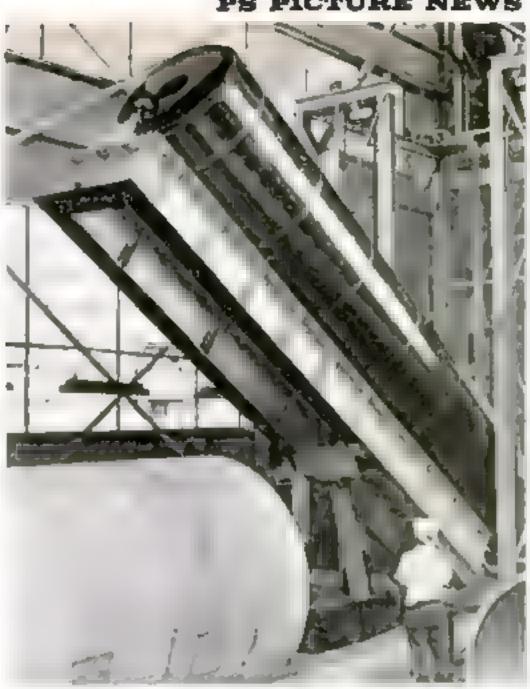
Finger-touch vault

Special hinges on this 33-ton door for a bank vault let you close it with one finger. The door is 10 feet high, 31/2 feet thick, and includes a two-foot slab of solid steel designed to foil cutting tools and explosives. It was built in London for the Bank of Montreal.



Slanted-door truck

It's easy to get in and out of the cabs of the new Austin and Morris trucks. The door is mounted at an angle behind the front fender. This provides room for a low step instead of one at hub height. The slanted window also gives better vision to the rear.



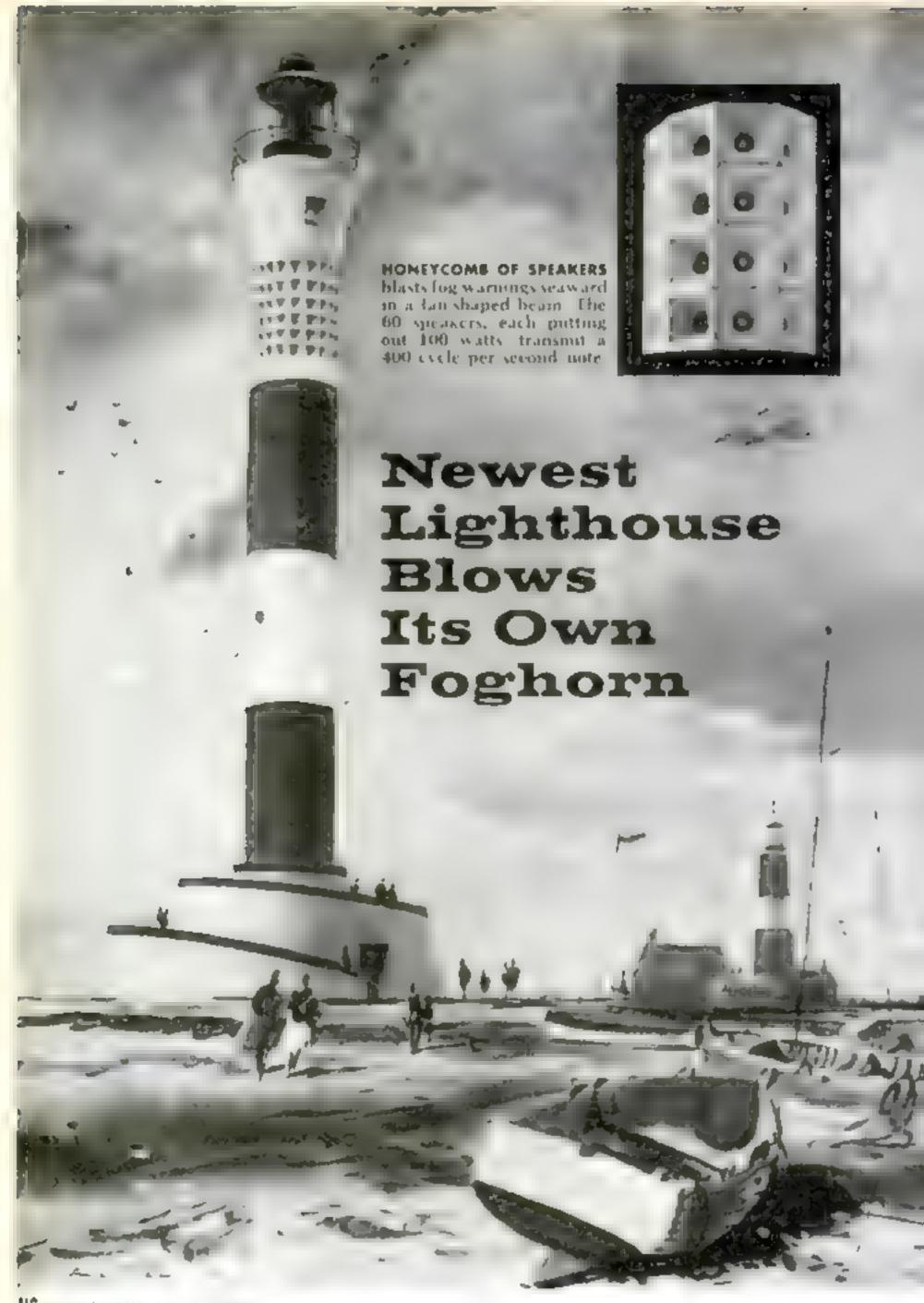
Container for missile

When a Navy Polaris missile travels, it will be protected by a shockproof shipping container weighing almost 11 tons. Inside the aluminumalloy sheath, which stands three stories high, are a two-inch foam-plastic insulating layer and a fiber-glass liner with electric heating elements to keep the passenger at uniform temperature.



Subway for rockets

The deeply buried tunnel above links a new block house at Edwards Air Force Base, Calif., with the rocket test-firing ground. It houses wire connections that transmit measurements of temperature, vibration, thrust, and other firing data.



HE world's most modern light-house will guard the western approach to the treacherous Strait of Dover, a 25-mile-wide funnel joining English Channel and North Sea. Currents rush through at speeds up to eight knots, eddying over shifting sandbanks. Fog or snow often blots out sight of land. Over the centuries, the elements have littered the bottom of this tricky passage with ships.

Set on an English headland at Dungeness, the new 130-foot tower will rise a half-mile from the old light—soon to be overshadowed by a nuclear power station. Precast concrete rings 12 feet in diameter, five feet high, and six inches thick will form the tower, with steel cables running up through the walls for reinforcement. The top two rings will be cast with a honeycomb of 60 apertures for fog-signal speakers. Above, the top flares out to hold the lamp. Black and white bands on the tower will never need repainting—color will be mixed in with the cement.

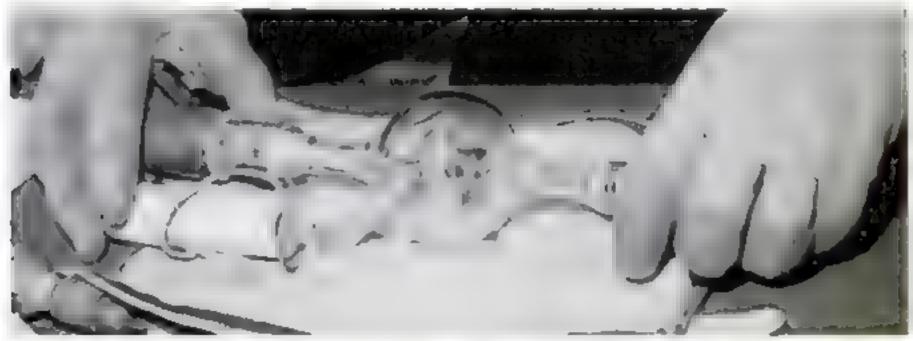
Inside the spiral base a control panel will do the keeper's job of operating the light, fog signal, and radio beacon. It can do this automatically or by remote control. Underground lines bring in public power; but if this fails, a diesel generator cuts in. If this also fails, batteries supply emergency current.

Flashed on and off electrically by a novel circuit arrangement, the Xenon arc is a unique light source for a lighthouse. Only a small, stationary drum lens fits around the arc. Conventional lights, burning vaporized kerosene continuously, use a large rotating optical system.



WHEN FOG ROLLS IN, this detector switches on the sound transmitter. Searchlight beam hits water droplets and part of it is reflected back to photocell (top unit) that translates light intensity into visibility. A relay triggers the foghorn at a predetermined range.

When fog billows in, it sets off the fog detector mounted on top of the base. The detector consists of a 20-inch searchlight, throwing a narrow beam equal to 35 million candles, and a telescope focused on a photocell. Both the light beam and the photocell amplifier are modulated by a 50-cycle power supply, so that only searchlight illumination bounced back by water vapor is measured. Daylight has no effect. At a predetermined range of visibility a motor generator sends a 400-c p.s. tone through the speakers.

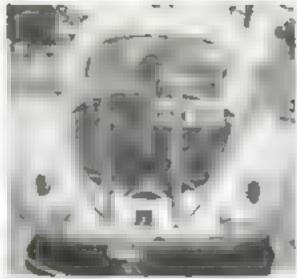


A 3,000-WATT MOVIE-PROJECTOR LAMP flashes on and off electrically to give the proper signal.

Unique for lighthouses, the high-pressure Xenon are lamp produces 750,000 candlepower.

PS PICTURE NEWS





"SNORKEL" EXHAUSTS and propeller are fitted to the back.

off for a jaunty sail.

"Boatswagen" takes to the water

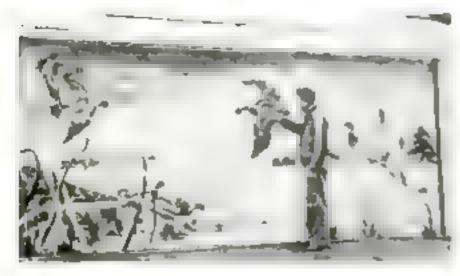
A dealer in Sydney, Australia, dramatizes the tight construction of Volkswagen sedans by taking prospects for a demonstration ride in the harbor. He drives a 10-inch propeller with the generator drive pulley and steers by turning the front wheels. The engine compartment rides partly submerged—ignition is sealed and there are extensions on the carburetor, oil-filler pipe, and exhaust stacks. To keep passenger space dry, heavy grease was smeared on the rubber door and window seals. Masking tape makes the hood tight. The modified VW has sailed for as long as 20 minutes, shipping only "a very little water."



Falcon by another name

A car that looks astonishingly like the Ford Falcon is being built in Canada, Called the Frontenac, its dimensions, tires, brakes, and steering ratio are almost exactly the same. Its engine produces the same horsepower. The grille and tail light are different and the body bears a medalhon.

You guessed it—it's the Falcon in the altered dress Ford of Canada puts on U.S. Ford products.



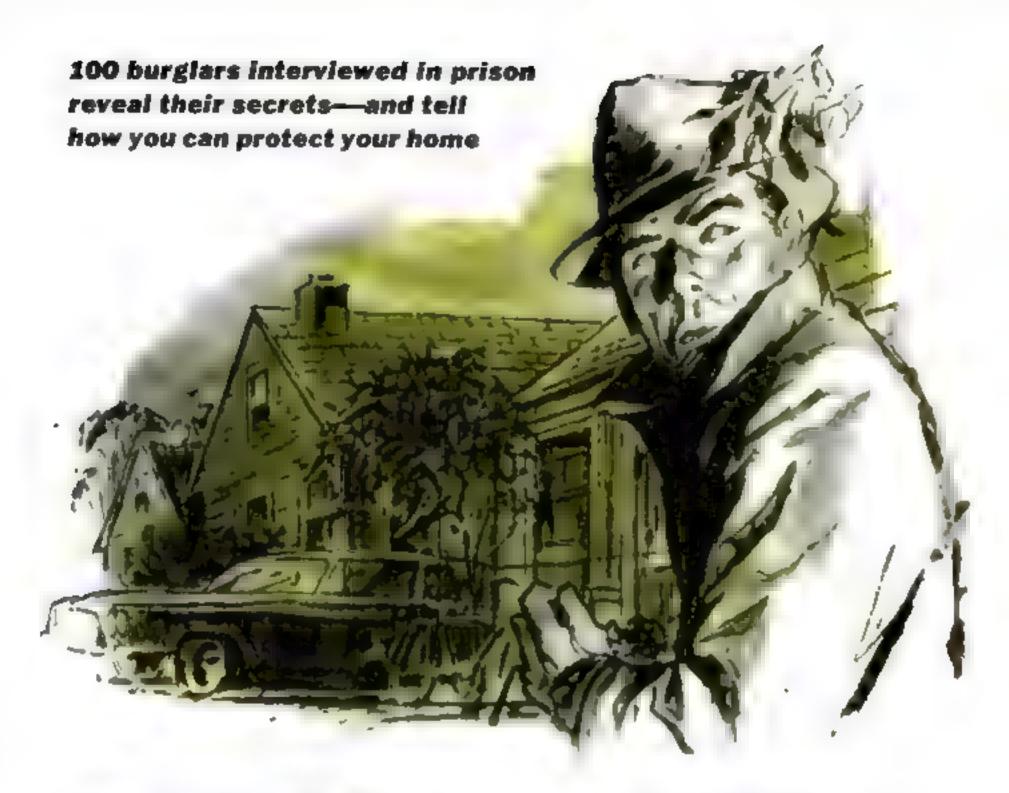
Garage-door mural

A full-color painting of mallard ducks on a lake is completed here by LaVerne Bleifuss, Wisconsin artist. The setting of the mural is the door on his brotherin-law's garage in Oconomowoc.



Amphibious sidecar

This motorcycle sidecar doubles as a motorboat when you reach water. The British-designed hull seats two adults on land or lake. It has its own built-in single-cylinder, air-cooled engine.



Your Best Defenses Against Burglary

This is probably the first personalinterview survey ever conducted among burglars. In preparing this article the writer talked with more than a hundred convicted burglars behind the walls of the world's largest prison, at Jackson, Mich. What follows is a true, up-to-date picture of residential burglary.

By M. Robert Beasley NE burglary is committed in the United States every minute of the day and night, according to the FBI. There are more burglaries, moreover, than any other one crime, and the percentage continues to rise. You can help reduce this menace, and simultaneously protect your valuables, by exercising a few simple home precautions,

The first is to recognize that it can happen to you. Many a man of modest means feels that his home is safe from burglars because it doesn't offer much plunder. This basic misconception enables many professional criminals to operate. Actually, the fact that you are an average citizen, with modest income and living habits, may make you a likelier target than a wealthy person in a plush mansion. As one burglar of 30 years' experience put it: "I'd rather hit little scores from two or three small homes in one night

What good is an expensive front-door lock when other

and be reasonably safe, than try a bigger place that is probably alarmed, and wind up with empty pockets and tangled with the law."

This is a common attitude among "cat men," as burglars are known in underworld parlance. Two other reasons underlie their preference.

One is that the loot they find in prowling small homes and apartments—clothing, luggage, sporting equipment, cameras, typewriters, television sets—is far more easily disposed of than costly furs or jewelry. Objects of modest value can be sold faster and attract less attention than special and very expensive items.

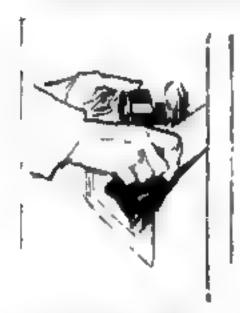
The second appeal of the small home is that it provides a burglar with a steady income during the time he is "casing a big score." He will often work three or four nights a week on small places, knowing in advance that he will average only 50 or 100 dollars on each job. But these sums supply him with ready cash and provide leisure time during the day to set up his "big one."

An experienced burglar may spend two or three months familiarizing himself with a jewelry store, warehouse, or supermarket. He may even get in touch with a "fence" to dispose of the merchandise before he ever steals it. All this takes time, during which he needs money. If he uses narcotics, as many criminals do, he may need as much as a hundred dollars a day for his drugs alone. Homes and apartments of average citizens supply this income.



The loot found in small homes and apartments— clothing, luggage, TV sets, and such—is easily disposed of.

How he breaks into a private dwelling



For spring-type snap locks, skilled hands need only a piece of plastic.

The commonest and easiest method of entry into private homes is through manipulation of spring-type snap locks. Skilled hands require only a thin piece of plastic—the kind found in any man's wallet. This is inserted between the casing and the door, directly in line with the lock. Since the snap lock has a beveled face toward the outside, the resilient plastic easily pushes the lock back. The door is opened instantly, without a sound.

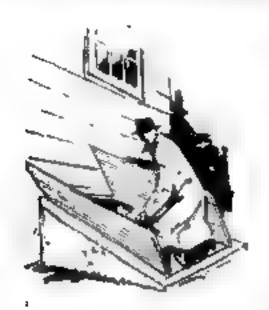
Many burglars prey exclusively on homes having this lock. They can get in as quickly as you can with a key and create no suspicion, since their rapid entry makes it look to a casual observer as if they actually used a key. Thickes specializing in snap locks require no special tools, an extra advantage since many states mete out heavy sentences for possession of burglar's tools.

To stop this easy entry, replace spring-type snap locks with dead-bolt appliances, which require a turn of the key for locking purposes. Such locks won't make your home invulnerable, but will discourage plenty of burglars.

Some other ways to invite burglars

It is a curious fact that many home owners will install expensive multiple locks on the front door, while other doors will be equipped with cheap locks for which skeleton keys can be obtained at any hardware store. Side and back doors,

doors can be opened with a hardware-store skeleton key?



Cellar doors are favorite ways in.

and basement doors and windows are favorite ways in. In suburban areas, thieves prefer to make their entry from the side or rear of a home where there is less chance of arousing

suspicion from neighbors.

These avenues of entrance can most effectively be closed through use of sliding barrel bolts on all service-entry doors, and with crossbar arrangements or hasp locks on the basement windows.

Doors having hinge pins on the outside are open invitations to the experienced burglar, too. All he need do is slip out the hinge pins, and the entire door can be lifted out even if you have a \$20 lock on the opposite side of the door. Check your hinges. If you find any like this, either reverse them or substitute safety hinges with pins that cannot be removed.

Little defense against forcible entry

An experienced burglar can almost always gain entrance if he really wants to. A knife-edged pipe wrench can unscrew a cylinder lock from a door in a few minutes. A pair of tire irons, applied with opposing pressure against door and jamb, will break open most doors quietly and quickly. Wide adhesive tape, placed across a window pane, will allow the glass to be broken without noise. The fact remains, though, that no burglar in his right mind would tackle tough jobs when he has a wide choice of easy pickings.

The easy way—in with Flynn by key

Many burglaries are committed with the help of the actual house keys. Families often have the dangerous habit of hiding a key for use by several family members, or in case of loss. Keys cached under door mats, on transom ledges, in mail boxes, or behind shingles, are used every day for felonious entry. If you must have a spare key, leave it with a trusted neighbor.

Another common, and frequently disastrous, habit is having your address in your key case. This may bring back your keys after loss. But it can also allow a crook to make duplicates, return the keys, and later burglarize your home. If you lose your keys, it is far better to let them stay lost. Having your locks changed is much cheaper, and less har-

rowing, than having a burgler visit.

Identification cards in key cases offer another threat to the unwary. Many people carry key cases in overcoat pockets. The coat may be checked in several different coat rooms. during a week. Some thieves have working arrangements with check-room people who turn over keys to them. Duplicates or wax impressions are made, and the keys are returned to your coat pocket. Armed with the address thoughtfully included with the keys, the thief is at liberty to enter your home whenever he desires. The best protection against this hazard, of course, is to keep your keys with you at all times.

If you have recently moved, the locks should be changed



Keys "hidden" under door mats are used every day for felonious entry.

on all doors. Many thieves move from month to month, renting expensive apartments and homes for the sole purpose of obtaining keys and familiarizing themselves with floor plans. After a month of occupancy, they move, returning the keys. But a duplicate set gives them a return pass to prowl familiar rooms when the place has been rented to the next tenant. This system is also worked with motel and hotel rooms. When traveling, check your valuables at the desk; don't keep them in your room. A person who occupied your room before you arrived might well pay you a stealthy visit.

And who says burglars go unarmed?



"I'd rather go on a job without my pants than forget to take a gun."

There's a popular belief that most burglars don't carry weapons. Don't you believe it! Over 90 percent of the burglars I interviewed considered a gun a necessary tool of their trade. "Whadda you expect me to do?" said one. "Go into a place 'naked' [unarmed] and have some joker corner me with a ball bat?" Another stated: "I'd rather go on a job without my pants than to forget to take a gun with me."

What should you do if you wake to hear the stealthy

movements of a prowler? Absolutely nothing.

The experienced burglar at work has set himself for a single emergency: detection. You are unprepared for the situation. Even if you have a gun handy, is your hand steady enough to shoot straight? Are you in enough command of yourself to move without a sound? If you start shooting, are you positive it isn't one of your family moving about? The answer to each question is probably no.

If you jump out of bed, even with a pistol in your hand, you are still at a disadvantage. The prowler, listening with acutely trained ears, will detect your first movement. Since he doesn't have to worry about who becomes his target, he may spray a lethal hail of bullets at you. Your best course is to lie quietly and do nothing. He'll take what he wants and silently fade into the night. While you may not have silverware at breakfast in the morning, you and your family will all be at the table.

Actually, the last thing the "cat man" wants is trouble. But remember that he is at an emotional pitch, probably hopped up on narcotics, and armed. He risks three dangers every time he breaks into a house: the police, prison, and death. He'll avoid these at all costs—even if that price includes your life. A criminal who will burglarize a home where people are sleeping is extremely dangerous. Your life

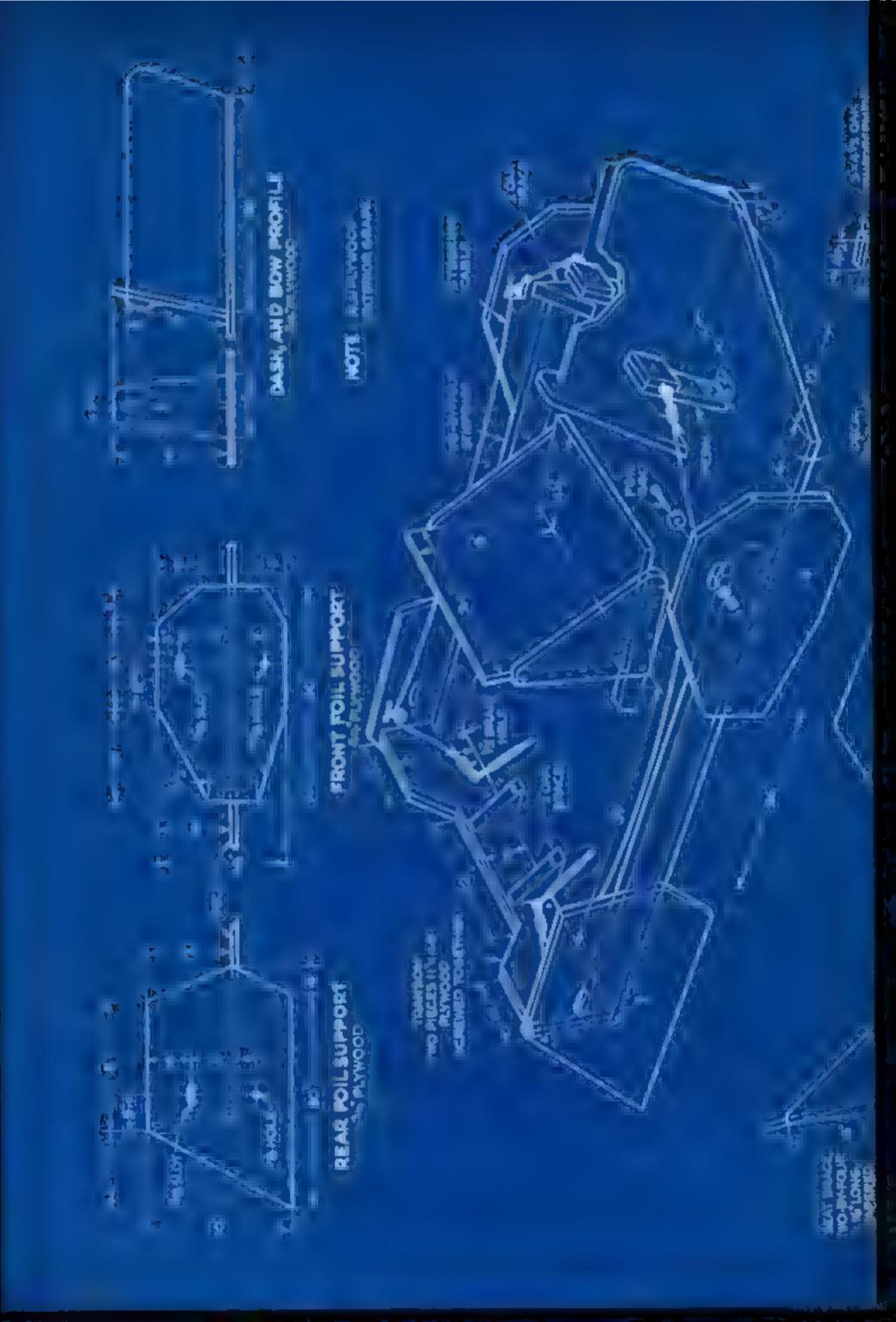
If you wake during the night and hear a noise downstairs, the situation is different. You are safely removed from personal harm, and have a weapon that the most hardened burglar fears—noise. Kick a chair against the wall, stomp on the floor; slam and lock your bedroom door; then turn on lights and call from the upstairs window to persons passing on the street. If you have a telephone extension in the bedroom, call the police. The burglar will vacate your premises in a hurry. And it is a perfectly safe procedure—provided you are upstairs and the thief is downstairs.

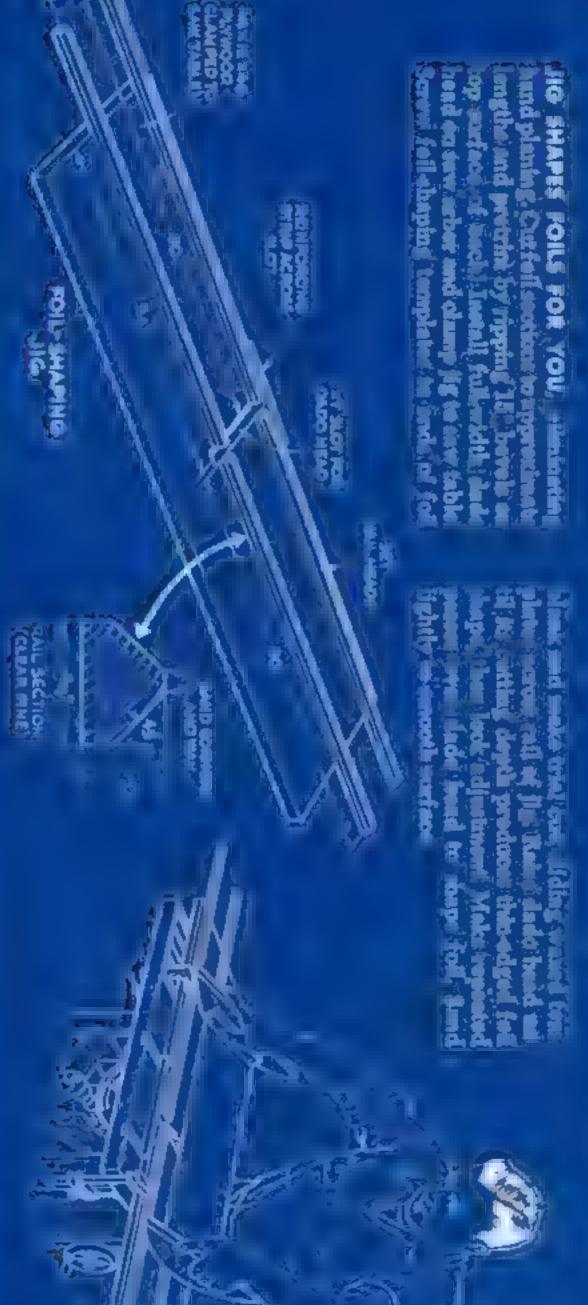
Occasionally prowlers, dissatisfied with the loot, have

[Continued on page 244]



If you waken to hear a prowler, DON'T jump out of bed.





MAKE RICHT AND PEDA

THE SCHOOL STATE OF

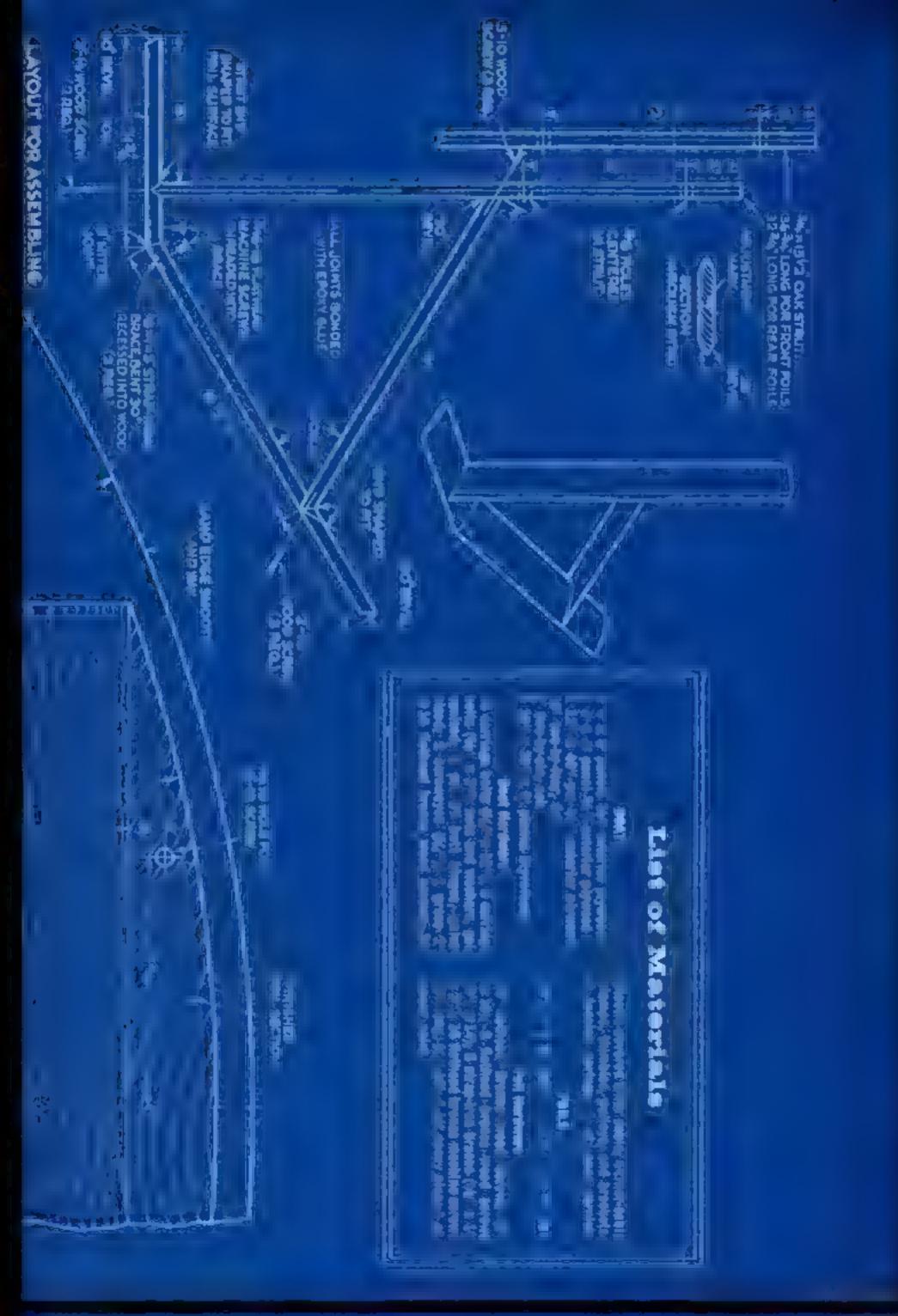
SED IN POAM

POPULAR SCIENCE MONTREE SESSESSES AND MOS Teck IN N. R.

FLYING PLATFORM BOAT

DESIGNED TO MAIN STATES

C) 1960 POPLAAR BCIENCE MONTHL.





Flying Platform Boat

It's a real quickie. Make it in two weekends . . . for \$116 . . . with a table saw . . . for unsinkable fun

By Herbert R. Pfister

HE first time I shoved the throttle forward on this little 4'-by-8' fun boat, it took my breath away. In an instant, I found myself flying more than a foot above the water on homemade hydrofoils, going faster and faster. My first thought was that I had no experience at this sort of thing. It didn't take long, though, to discover that flying a boat is one thrill you can enjoy without special training.

Here is your FREE BLUEPRINT

In calm water, with a 10-hp, long-shaft motor, I flew the crazy little craft at 35 m.p.h. (clocked by an escort boat with a 40-hp, kicker). I found that rough water slows the boat the way rough air slows a plane, and brisk crosswinds m. ke it difficult to keep on course. It is like flying.

The largest single item of material is

You can fashion
these wings of oak
on your table saw

PERFECT CHORDS, foils are
thin at the edges, curving to
%" thickness at the center.
A jig shapes them; you supply only the muscle.

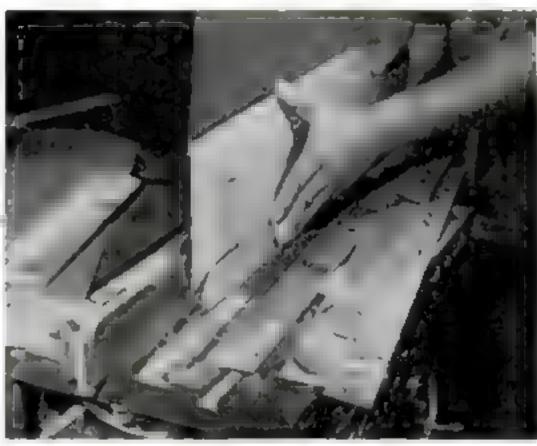
4. PARTLY SHAPED FOIL shows how curve of template is reproduced on surface of oak. Make repeated passes, feeding the edge into the blade intil half the surface is shaped. Then turn foil around and shape opposite edge to complete it.

the Styrofoam used to make the unsinkable hull of the boat. To save time, place your order for the Styrofoam* and begin work on the foils while you're waiting.

You need two widths of oak to make the foils. Struts are 5½" wide and the foils themselves are 7" wide. Widths of hardwoods vary, so try to get the nearest width that will allow enough for trimming.

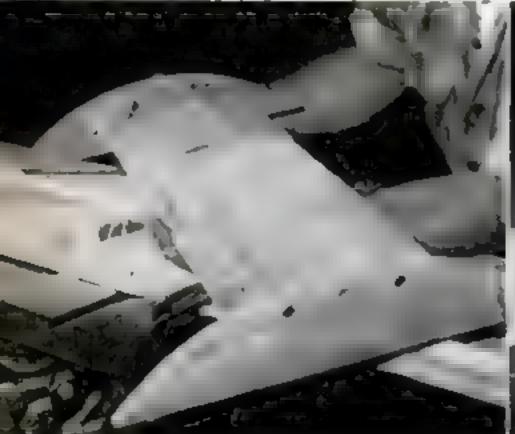
The method of shaping the oak into a smooth airfoil section is outlined in the photos below. Take pains to make dupli-

*You can neder Strendman planks from Done Chemical Co. Process Subscription Mediand Unit Don with forward your order to the doct but t negrest your town. Prinks 10" by 20" by 9' cost about 519 aprece, plus shipping charges.



1. CUT ALL FOIL SECTIONS 7" wide and slightly longer than specified. Pretrim pieces prior to shaping by cutting a 15-degree bevel on each side of top surface. If oak has slight crossgrain warp, use concave side for bottom of foils.

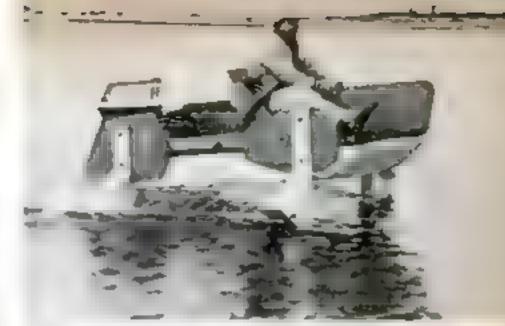
5. ONE TRICKY JOINT, where end of upper foil joins curve of lower foil, is made easy by using the saw as a jig. Unplug line cord and set blade at 30 degrees to support upper foil. Use half-section of pencil to lay out curved cut.





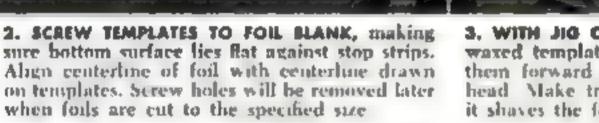
cate parts for all four foils (except struts) and assemble them over a plan drawn on plywood so they'll be identical in shape and provide uniform lift in the water. Have no qualms about the thin oak sections supporting you, the motor, and the boat. The epoxy glue combined with screws produces joints that are as strong as the wood itself. After the glue sets, file away any globs that have squeezed out, but leave a light fillet over each joint. Sand smooth and cover with two coats of epoxy paint for a smooth, drag-free finish.

Construction of the boat requires no boatbuilding skill. Just cut the plywood



FORS ARE THIN but strength is designed into them. Once they plowed into a mod bank at full throttle without cracking. Caution: They're sharp, so stay far away from swimmers.





6. AFTER CUTTING, sand curve on drill press with table tilted 30 degrees. Lacking a drill press, you can shape the curve with a half-round ble, using a 30-degree guide block pressed against the foil bottom to maintain films angle.



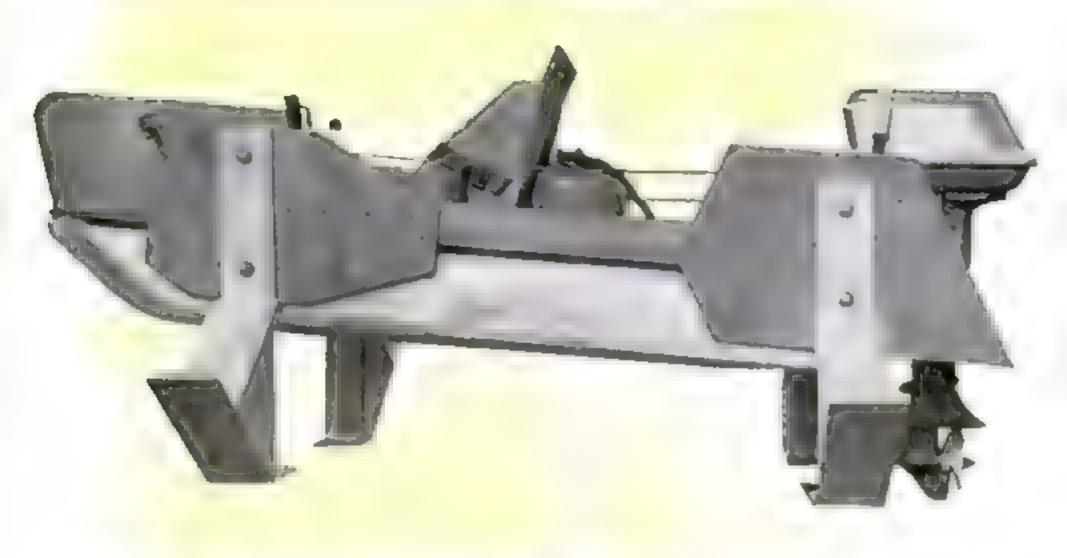
3. WITH JIG CLAMPED IN POSITION, press the waxed templates on the rails and slowly slide them forward to pass the oak over the dado head. Make trial cuts, raising the blade until it shaves the foil edge to 1 42" thickness.

7. ASSEMBLE FORES over layout drawn on a smooth surface. Fit all parts and screw them together. Then unserew parts and reassemble them with epoxy glue in each joint. No clamps are needed; screws draw parts up tight.





Foils are adjusted to boat by trial-and-error method



TO MAKE INITIAL FOIL SETTINGS, stand boat on foils on level ground and plumb all four struts (note rear struts are shorter). Mark basic set-

tings on foil supports. To get best performance from the foils, vary adjustments one degree at a time during trial runs in calm water.

pieces and screw them together. Note that exterior-grade plywood is specified. All parts fastened to the deck, including the transom, should be secured with screws driven in from the underside.

When the woodwork is done, bolt the Styrofoam to the underside of the deck Shape it with a handsaw and rasp, and sand it smooth. There's enough foam under the deck to keep nearly 1,500 pounds afloat, so don't be afraid of removing too much material when you shape the bow and rake the bottom at the stern.

Fasten the foils to the supports with %"-by-3" galvanized carriage bolts. To keep the bolt heads from sinking into the plywood when the nuts are tightened, fit 3"-diameter washers cut from maple or oak scraps to the square section of each bolt. Since you'll be tightening these nuts on the water, tie your wrench to a chunk of foam. If you should drop the wrench, the foam will keep it from sinking to the bottom.

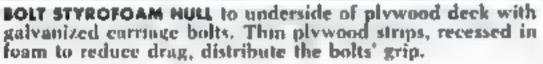
Rig the boat with tiller cable and remote controls to fit your motor. An automotive-type safety belt with quick-release buckle and a brass handle on the dash are the final touches.

The boat has stubbornly refused to tip over during tests, but you might have a bumpy ride as the foils bite into rough water. Steer with your feet as you would steer a sled—push the right pedal to turn left and vice versa.

Flying the boat is largely a matter of getting the feel of it. From a standing start, push the throttle full ahead, then pull it back slightly as the boat rises and becomes foil-borne. In calm water, once the boat is full up, it will gradually pick up speed at ¼ throttle. Slowly advance the throttle to gain more speed. Slight adjustments in the foil angle and motor trim can eliminate any tendency to porpoise at full throttle. With a sensitive throttle hand, it's possible to fly for miles without porpoising.

Steering is tricky. Only slight changes in direction can be made under full headway. For a tight turn, you must throttle back for a moment, then gun the motor as you steer to kick the stern around and bank the boat.







Cut patch block larger than dent (above). Then gauge out dented area to receive it. Cement patch with special foam cement—ordinary cellulose cement will dissolve it—and smooth with coarse sand-paper folded over block (below).

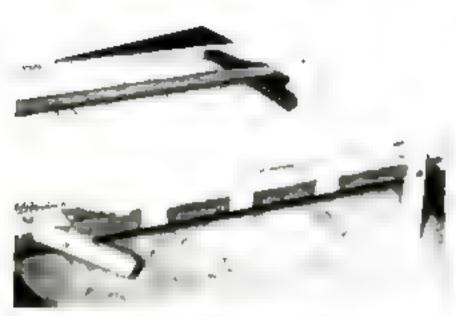


Next Month...

YOU'LL get detailed instructions for mounting these same foils on any runabout up to 16 feet. An 18-hp. long-shaft motor was used to fly the plywood 14-footer shown below. With two passengers in the front seat, the foils were carrying a gross weight of nearly 1,000 pounds. And best news of all for you. The foils can be made for less than \$25, including their supports.

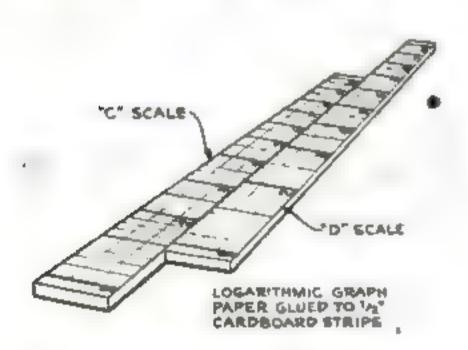






Legs for Drawing Board

If you must do drafting on the kitchen table you'll find these drawing-board legs valuable. Mounted at the top of the board, they can be sized to hold it at just the right slant. They're notched to lock in position, held there by coil springs under the screw heads. They can be turned out of the way easily, too.— W. C. Anderson, Arlangton, Va.



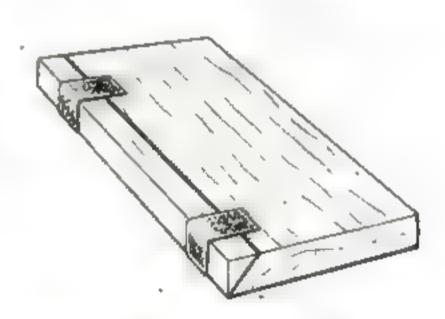
Slide Rule from Graph Paper

A DRAFTSMAN in the field without his slide rule made one in a few minutes. He pasted logarithmic graph paper on two \frac{1}{2}"-wide cardboard strips to simulate the "C" and "D" scales of his regular slide rule. He marked the two scales from one to 10 exactly as the graph paper was marked. By sliding one strip along the other, he was able to work multiplying and dividing calculations easily and rapidly.—Rasil Jackson, Downsview, Ont.



Clamp for Radiator Work

To hold the top tank or header in position for soldering to a radiator core, we use this holder made from a wheel puller and extension arms of 1/4"-by-1" flat steel. Thin bolts through the radiator core hold the clamp in place. With the clamp tightened, you have a no-hands means of holding the work while you solder it.—Harry J. Miller, Sarasota, Fla.



Protecting Beveled Edges

WHEN you must carry a number of mitered boards, protect the edges from damage by taping the waste strips back in place.—G. E. Hendrickson, Argyle, Wis.

Here's a trick to keep glue from soaking into wood and leaving a joint starved. Glue-size the pieces that come together—using about five parts of water for one of glue. This serves to seal the wood.—

Ernest R. Hickman, Grand Rapids, Mich.

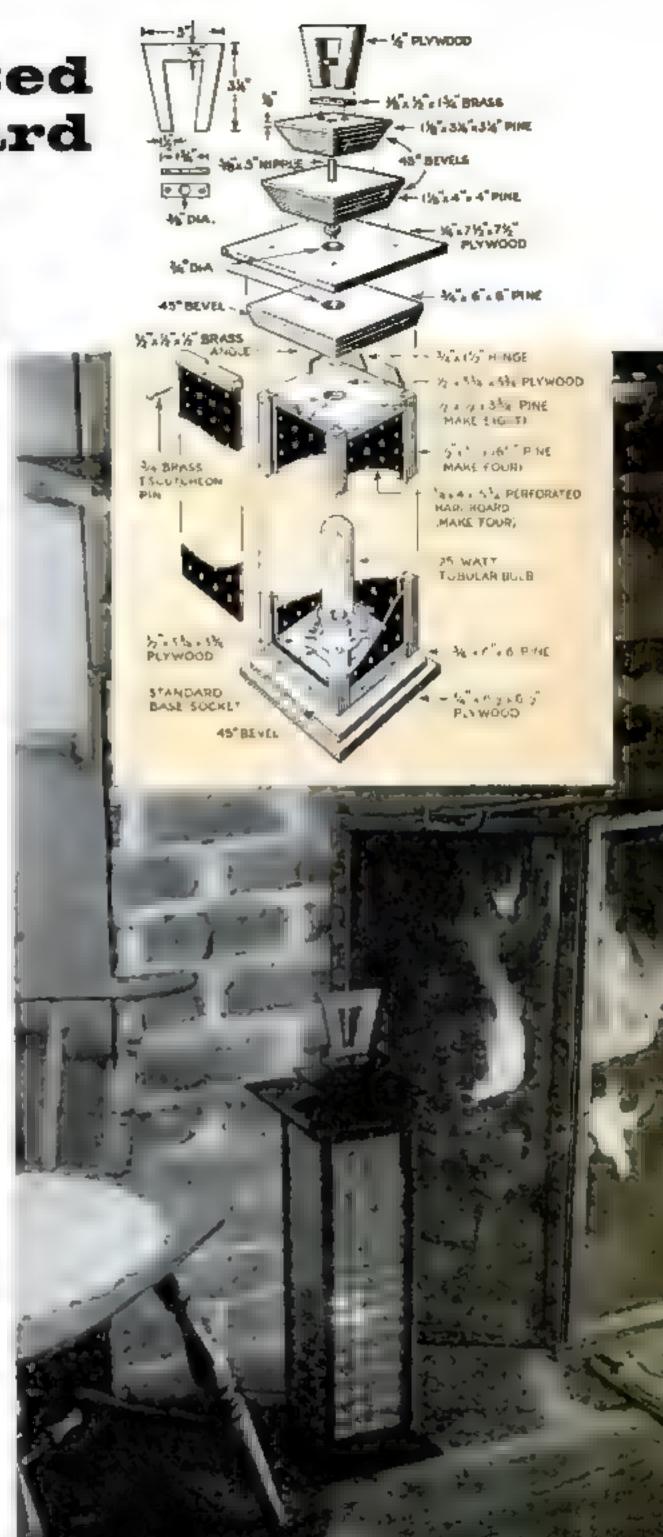
Perforated Hardboard Lantern

This decorative lamp combines the new and the old. Its styling is modern Oriental. But like many lanterns made in the days when only the rich could afford glass windbreaks for their candles, it projects its light through hundreds of tiny holes. With an unfrosted, tubular bulb behind its perforated-hardboard sides, it will paint your hearthstone or table top with bright radiating rays, and the walls beyond with vertical bands.

There's nothing tricky about the construction. As the drawing shows, three of the lampbox panels are locked permanently in place by framing strips with 1/8"-square grooves cut in their sides. The fourth (front) panel, with a top framing strip glued to it, slides freely up and down in similar grooves. Both the top and bottom of the lamp are built-up assemblies. The former is hinged at the back, and held in place at the front by an escutcheon pin. The pin passes first through the framing member on the sliding panel, then through an L-shaped bracket screwed to the underside of the top, and, finally, into the body of the lamp box. To replace a bulb, you remove the pin, swing back the top, and slide the panel up.

For a bright, warm glow, the interior of the lamp box is painted gold. The panels may be any color; cherry red is a good choice. The frame is black, accented by a coat of antique copper on the handle, —Henry B. Comstock.

Ш



My PRIZE project is...



...a water plane

This plywood model of the Mustang fighter has a 2½-hp, engine that pulls it along at about 10 m.p.h. The plane has working controls, and an instrument panel with lights and switches powered by a bicycle generator on the engine shaft. My two sons love to "fly" it over the water.

LAWRENCE JUENGEL, Rochester, Minn.

...an auto-parts tractor

Usen auto parts went into this tractor. It has two transmissions, hydraulic brakes, and a disk clutch. It's powered by a two-cylinder, air-cooled motor that drives it about one m.p.h. in first gear at full throttle. The tractor is 4' wide and 6½' long.

CHARLES B. FRYE, Edinburg, Va.

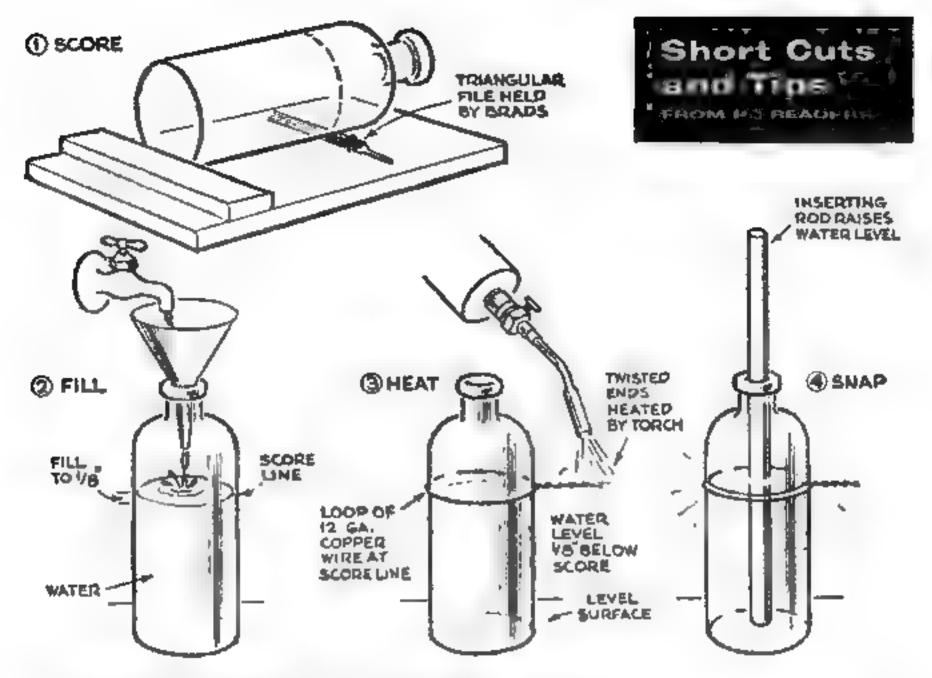


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...a private steamboat

A TWIN-CYLINDER engine drives the paddle wheel of this steamer. The boiler is a steel tank with heavy-gauge copper tubing running beneath it and up one end, similar to a water-tube boiler. I fire it with soft coal, and have plenty of steam for the engine and whistle.

J. LANE SCHUCKER, Sylvania, Pa.



You Can Cut Bottles Accurately by This Method

I CUT bottles and jars with consistently good results, using the four-step method outlined in the sketches above.

First, I score the bottle. I do this by revolving it against a triangular file attached to a board (Fig. 1). The bottom of the bottle is held against a wood stop block to guide the score. Then I fill the bottle with water (Fig. 2) to within \(^1/6''\) of the score line. Next, I wrap 12-gauge copper wire around the score and twist the ends of the wire together. I apply a

Steering Gear Drives Auger

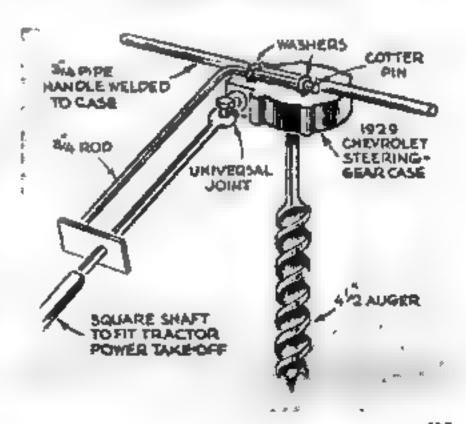
My power-driven post-hole auger was made from the steering gear of a 1929 Chevrolet. I welded a universal joint in the steering-wheel shaft, and welded an auger bit to the shaft that used to turn the front wheels. Only an old-time steering gear can be used like this; it must have full worm drive. Modern steering gears can't revolve the required 360 degrees.—A. Hiebert, Coaldale, Alberta.

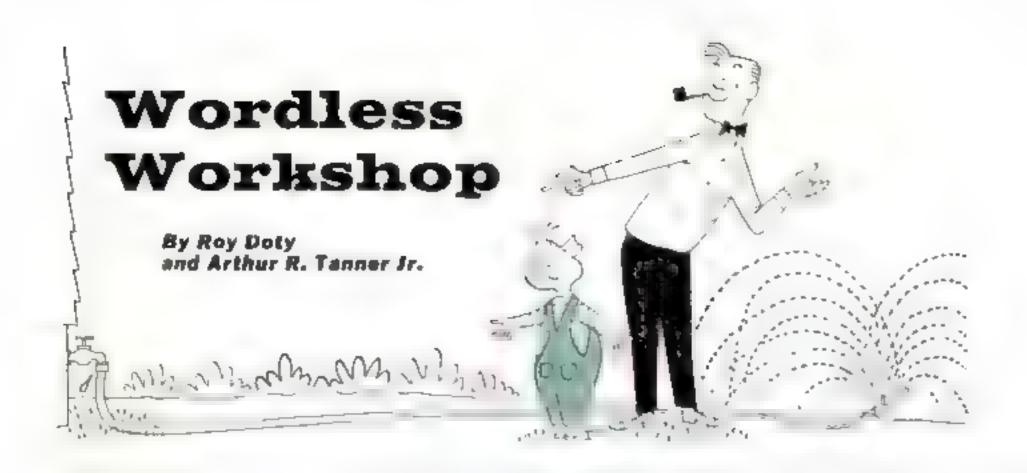
▶▶▶I MAKE a cheap, effective layout dye by crumpling carbon paper in a small jar, adding alcohol and a half-teaspoonful of shellac.—C. G. Sykes, Newton, Iowa. torch (Fig. 3) to the twisted ends. The wire carries the heat around the bottle.

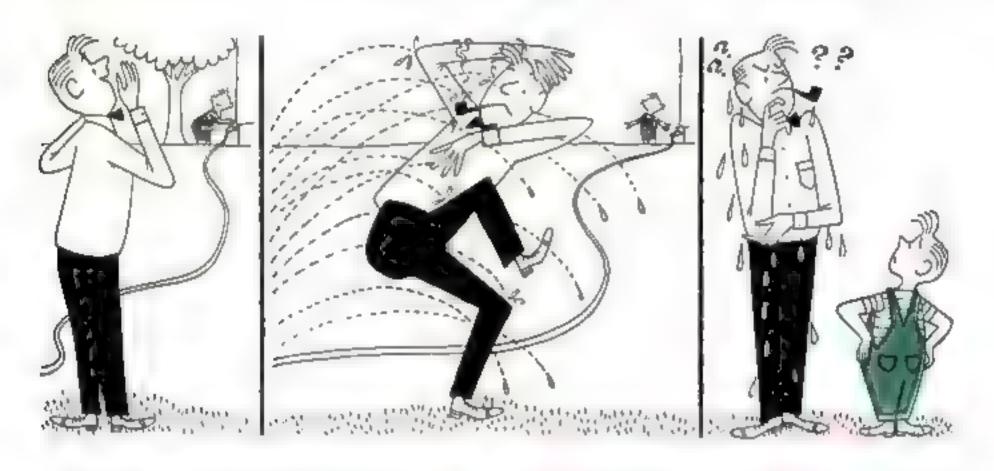
Finally, I plunge a wood or metal rod (Fig. 4) through the neck of the bottle and into the water. This raises the water level, the water cools the heated score line, and the bottle snaps apart.

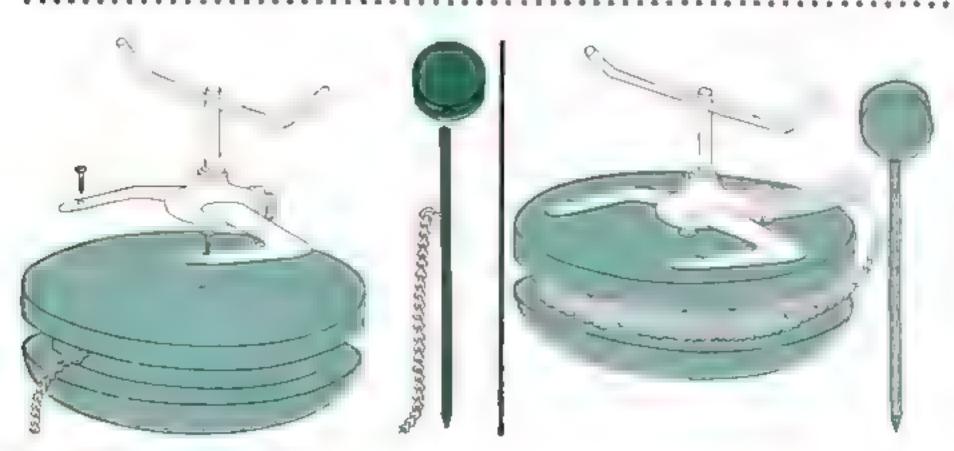
Any sharp or uneven edges that remain I smooth with a whetstone, keeping both the stone and the glass under water to keep the edge from becoming opaque.

W. C. Wilhite, Carlinville, Ill.

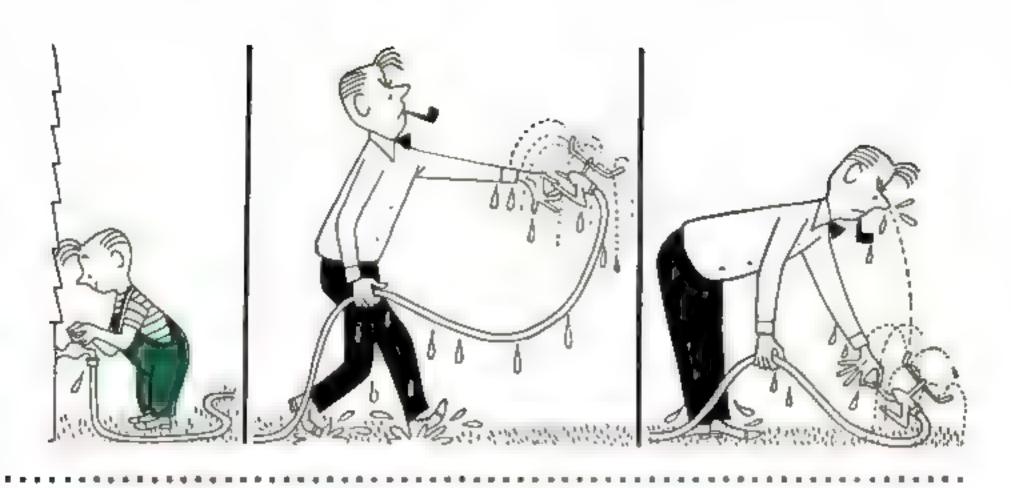


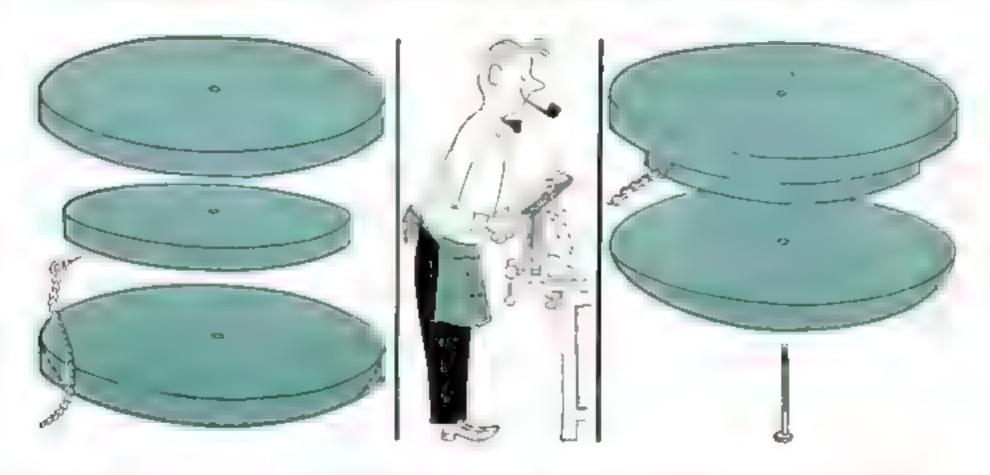






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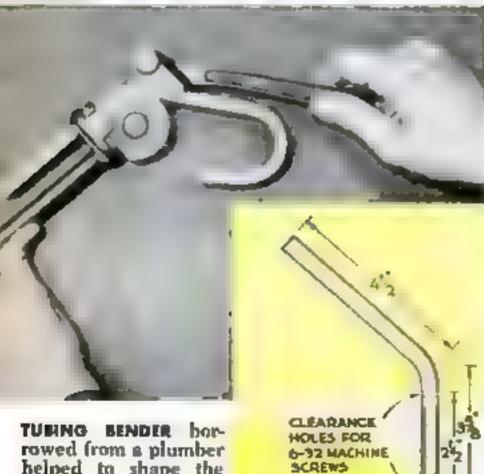






Stairway Coat Rack





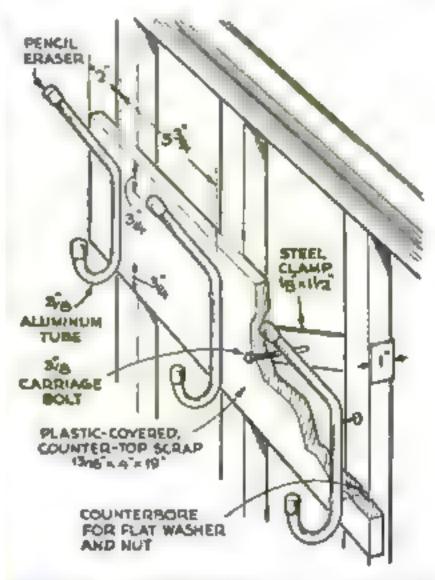
TUBING BENDER horrowed from a plumber
helped to shape the
hooks from %" aluminum tubing. The hooks
were polished with
fine emery cloth, then
hacquered to keep
them bright.

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FASTENED to the outside of a stairway, this coat rack takes up little space, yet is within handy reach of the front door. Being slanted, it provides low hooks for youngsters and higher ones for grown-ups. It's held by a single clamp that makes it easy to put up and take down without damaging the balusters.

The backboard is a scrap piece of counter-top plywood faced with plastic laminate and painted around the edges. The hooks were bent from \(^4\gamma''\) aluminum tubing. This can be bought at hardware stores or salvaged from an old TV antenna. The hooks can be shaped in a tubing bender or by filling the tubing with sand and bending it around wood blocks.

—A. R. Tanner Jr., Poughkeepsie, N. Y.



FELT-LINED CLAMP holds the rack against the balustrade. For easy removal, the rack is held by a single 3x" carriage bolt and wingnut. A second clamp should be added for heavy loads.





Short Cuts and Tips

Masking Designs for Spraying

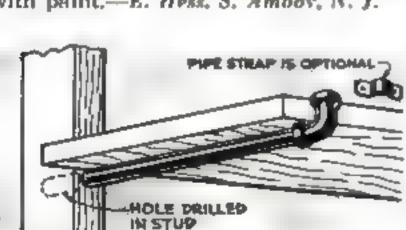
With a little petroleum jelly, you can protect delicate decals during spray painting. Using a swab of cotton twisted around a pointed stick, coat the design with a thin, smooth layer of jelly. Then spray the object. When the lacquer is no longer tacky but is still soft, wipe the coated areas with a cloth moistened in cleaning fluid. This method depends on the reluctance of finishing matetrials to dry on greasy surfaces.-Walter E. Burton. Akron, Ohio.

Making Neater Tape Wrappings

Rip friction tape in half for neater electrical repairs. The completed wrapping will lie closer and flatter on the wires and the job will take less tape.—

T. C. Van Alstyne, Don Mills, Ont.

►►►A HAT pin or needle can be used to locate a stud in a plaster or plasterboard wall. The small holes are easily covered with paint,—E. Hess, S. Ambov, N. J.

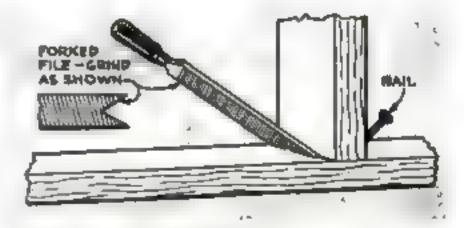


Shelf Brackets from Pipe

SHORT sections of pipe make sturdy brackets for shelves in the garage or shop. Simply place them in holes drilled in the studding, and lay a board on them. Elbows and pipe straps can be added to hold the shelf securely to the pipes.—

Laurence H. Victor, Corning, N. Y.

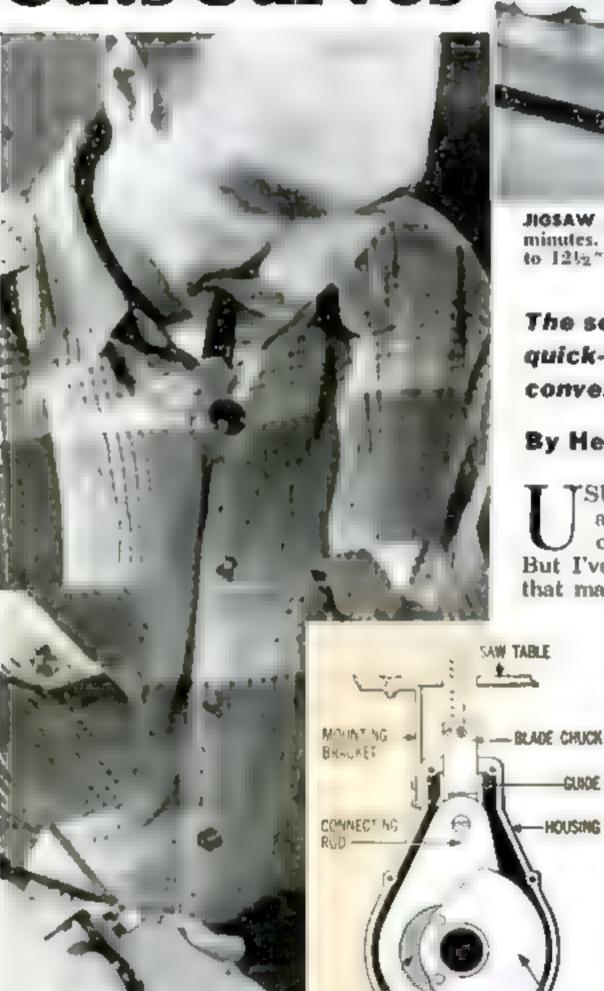




Tool for Toenailing

When toenailing joists, studs, or rafters, a home carpenter will find that this tool holds the work squarely on the line while the first nails are driven. You make the tool by grinding one end of an old file to a forked shape.—Burton L. Wollenzien, Grand Junction, Colo.

Now My Bench Saw Cuts Curves



ECCENTRIC



JIGSAW CONVERSION takes less than two minutes. Adjustable overarm offers from 10" to 1212" throat depending on table size,

The secret is an inexpensive quick-change attachment that converts to a jig-or saber-saw

By Henry B. Comstock

GUIDE

HOUSING

COUNTERWEIGHT

SUALLY I take a dim view of attachments designed to convert one power tool into another. But I've just bought a conversion rig that makes sense. It's four pounds of

well-engineered hardware that lets me turn my bench saw into either a jigsaw or saber sow almost as fast as I can change blades.

The heart of this \$18 Sears, Roebuck attachment is a small, banjo-shaped driving mechanism that fits on practically any 1/2" or %" saw arbor. Inside is a ball-bearing eccentric that converts the rotary motion of the motor to the reciprocating motion of the blade.

The driving mechanism is fastened to the arbor just like a circular-saw blade. To hold it upright, an Lshaped bracket on the housing is attached to the

DRIVING MECHANISM mounts on the arbor like a circular-saw blade and is braced by a bracket boited to the table. The counterweight, opposite the eccentric, cancels out vibrations.



\$ABER-\$AW CONVERSION takes only about one primite. With this setup, you can handle panels of unlimited size and breeze through 2½," pine.

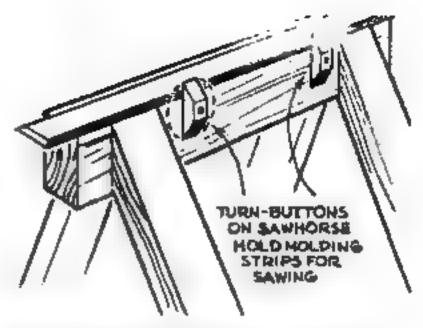
underside of the table insert with a machine screw. When adapting your saw, you have to drill and countersink a hole in the insert to receive this acrew.

Exactly 1½ behind this hole you drill another hole for the saw blades. Sears sends along a template to make this hole-spotting easy if you're using one of their saws. With other brands, you're on your own, but there's nothing tricky about the job.

For jigsawing, you simply add an overarm. When you first install it, you bolt the lower end of the arm between two brackets, line it up with the driving mechanism, and attach the brackets to the back edge of the table with a pair of clamps. You only have to do this once. From then on, whenever you want to put on the arm, you just bolt it to the brackets, which remain permanently attached to the table.

Without the arm, my big saw table lets me waltz large panels through a saber blade with better control than I've ever achieved with a portable saber saw It also gives me a completely unobstructed view of the blade and guide lines for easier cutting

As a jigsaw, the nice counterbalancing of the eccentric to eliminate vibrations, combined with the massiveness of the table, makes delicate sawing with fine blades smooth and accurate. I have only one complaint—I can't make bevel cuts because the mechanism is anchored to the table. But for many other cuts, it sure is a dream,



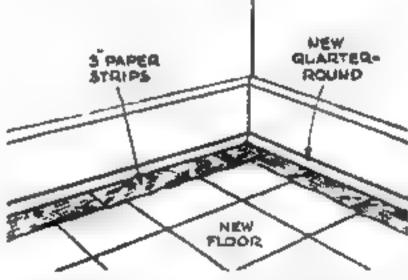
Holding Moldings on a Horse

To keep molding strips from sliding or twisting while he cuts them on a sawhorse, one workman I know uses wooden turn-buttons, as shown. Attached with tight screws, the buttons can be turned up for use or out of the way.—G. Hendrickson, Argyle, 4 is.

Oiler for Small Machinery

When oiling clock works or other small machines, use an eyedropper with a pipe cleaner inserted in it to serve as a wick. You'll avoid flooding the bearings because pressure on the wick applies the oil in small, easily controlled amounts.





Masking Molding for Paint

When installing new quarter-round or shoe molding around the baseboard of a room, place 3" strips of newspaper or wrapping paper under the molding before nailing. The strips will catch paint and keep it off the floor. After painting, trim off the paper along the base of the molding with a knife.—

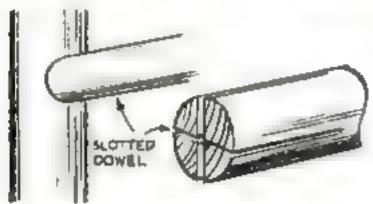
Lacrence Vickers, { tica, \text{ \chickers, \chickers

Short Cuts and Tips

Use a Ball Pen for Marking Balsa

A PENCIL is unsatisfactory for marking balsa. The lines are hard to see and the pressure required crushes the soft fibers, leaving splintery edges when cuts are made. Even a cheap ball-point pen draws clear-cut lines, and very little pressure is needed.— Harry II alton. Il late Plans, V. Y.





Slotted Dowels Fit Tight

Spare yourself the task of sanding down dowel ends to fit into holes that were drilled with a bit of the same diameter. Cross-slotting with a dovetail- or back-saw makes them easy to drive in for a tighter fit. This works, too, on tenons that must be squeezed into snug mortises.

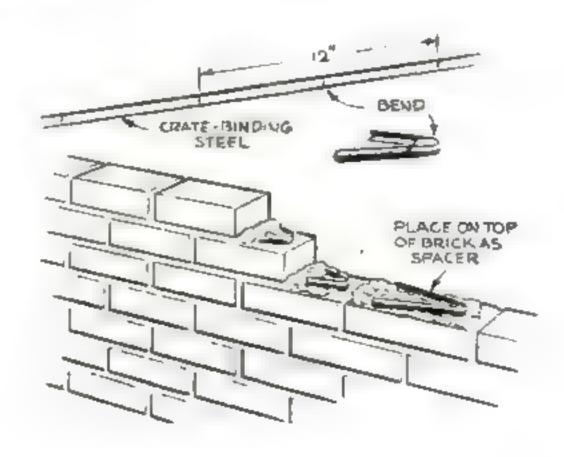
—Daniel Bousha, Jackson, Mich.

Homemade Spacers Keep Bricks Even

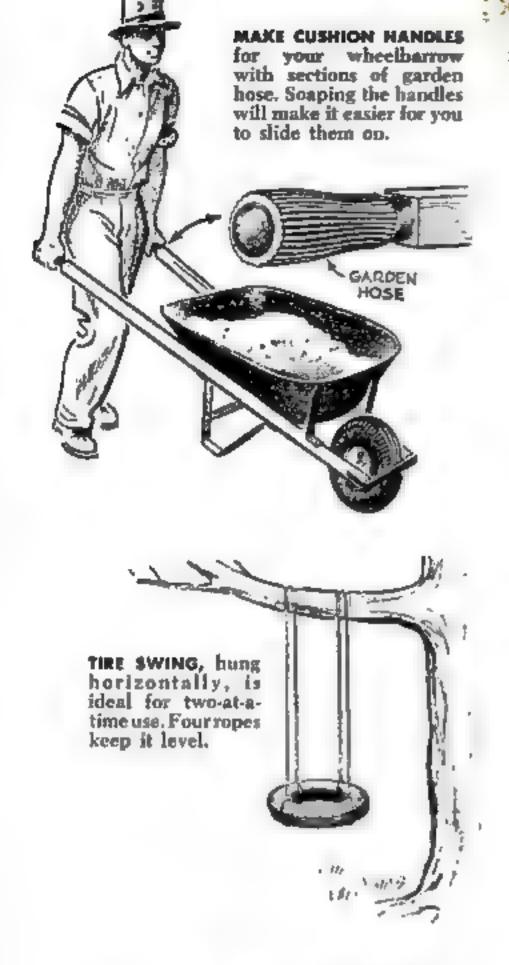
You can get neat mortar joints in brick walls with homemade spacers bent from the binding steel on old crates. Cut the steel ribbon (preferably $\frac{3}{8}$ " wide, but not more than $\frac{1}{2}$ ") into 12" lengths and fold them into V shapes. As you mortar each brick, set in a spacer and place the next brick on top. Longer spacers can be used with cement blocks.—Vernon Lamont, Great Neck, N. Y.

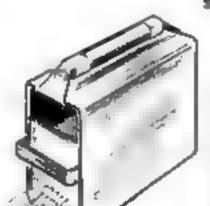


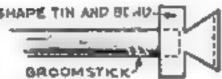
When a kitchen table or desk rests against a wall, the wallpaper or paint often gets scuffed. To prevent this, staple a length of 1/2" felt along the edge of the furniture that faces the wall. The kind of felt that's used for weather stripping is readily available and serves well.—Basil Jackson, Downstress, Ont.



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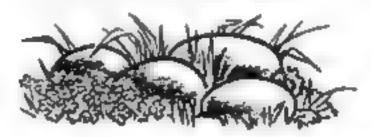
SAVE YOUR WATERING CAN for water. For weed killers, make a special poison sprinkler. Punch holes in the top of a 10-quart oil can, then cut out the spout to form a filler opening.



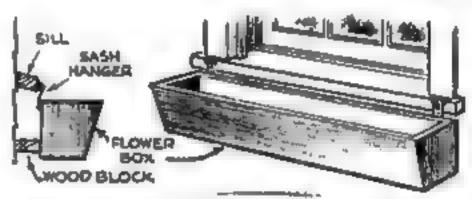
MAKE A BIRD SATH
at low cost. Set a
vitrified-clay sewer
pipe in the ground,
flange up. Then
place a large flowerpot saucer or ceramic pie plate on it.

7 Projects for the Back-Yard Handyman

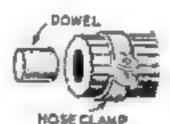
DECORATIVE "STONES" for gardens can be made by molding mortar in a cloth bag. Hang the bag until the cement hardens to produce round stones; lay it flat for flat ones.



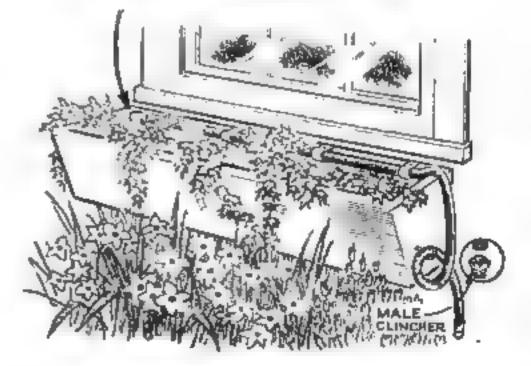




HANG WINDOW SOXES from each hangers and you can unhook them quickly for storage or painting. Use two hangers on small boxes, more on large ones. Wood blocks keep the boxes level.

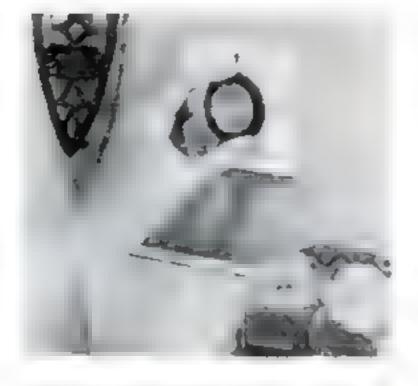


spainkless for window boxes can save you crawling through shrubbery to water them. Clamp a short length of perforated hose to each window sill so it can be connected to a hose.



Remote Control for Hot Water

A new hot-water heater gives 30 to 50 gallons of hot water an hour according to a family's needs. You set either of two dials—one on the unit itself, the other on the kitchen wall or any other place in the house. This regulates the flow of gas to the burner for a high or low flame. It doesn't change the temperature, but it does determine the heating rate. With glass tank, \$140; copper, \$200, Rheem Mig. Co., 7600 S. Kedzie Ave., Chicago.





ROOFING SQUARE finds all nine cutting angles for a hip roof at one setting. You move the fence of the British tool to desired roof pitch, given in degrees on one blade, and its various members are positioned automatically. You can also obtain lengths of required timbers without the necessity of complicated calculations, Price, \$26, D. Turet, 10 Village Station, NYC.



JIGSAW TILTS to 45 degrees on either side, has rip guide and circle cutter. It's powered by a 31 amp motor and can cut through two-inch wood, ½-inch aluminum, or ½-inch steel \$29.95. SpeedWay Div.-Thor, 1421 Barnsdale Rd., LaGrange Park, Ill.

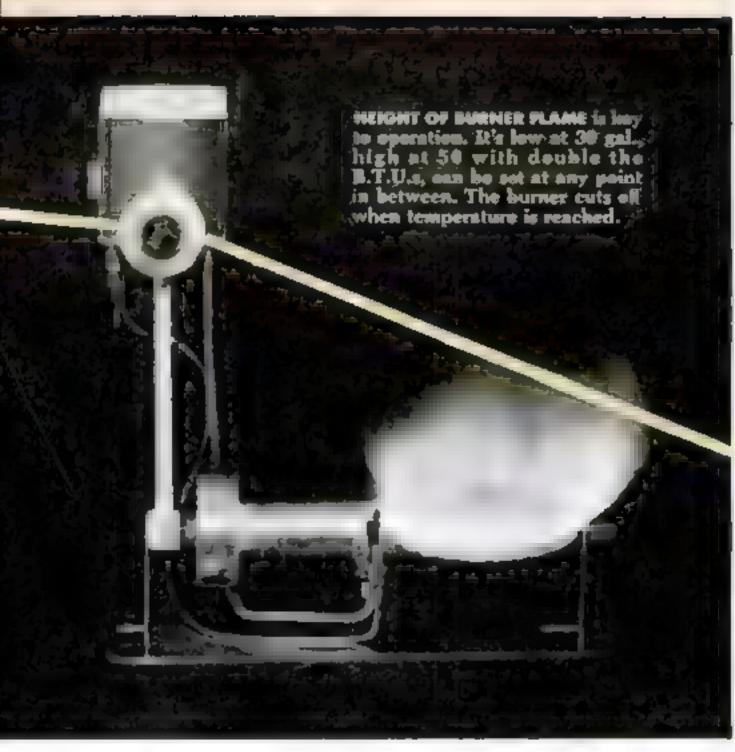


to the composition of a shock-absorber replacement use a cushion of air and oil to support heavy loads without affecting riding comfort. Air pressure is raised with a tire pump for extremely heavy loads. Gabriel Co., 1148 Euclid Ave., Cleveland.



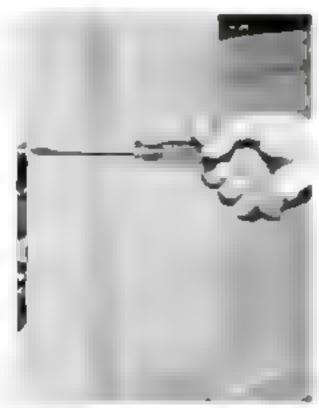
safety Harness is like parachute harness used by U. S. airmen. It's made by the designer of the Cornell Safety Car [PS, Dec. '56]. A ring sliding on an anchored strap lets the tot sit or stand. \$12.95. New Products Research, Box 166, Orchard Park, N. Y.

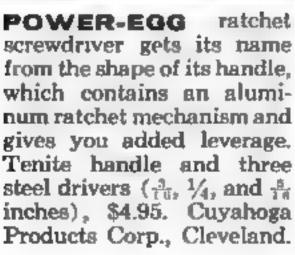
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MASTER DIAL is on the heater, but can be controlled from kitchen, bathroom, or laundry.







EPOXY SOLDER is a two-tube unit operated by a single key. Simultaneous ejection assures you proper proportion of resin and hardener. Solder hardens in four hours, can be machined like metal. \$1.79. Fybrglas Industries, 3010 W. Montrose Ave., Chicago.

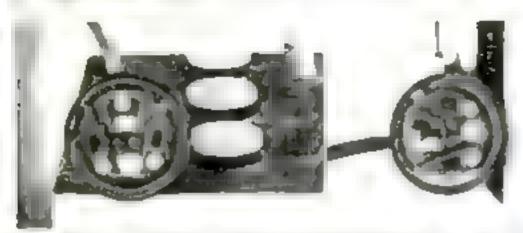
REFRIGERATOR can be run from a dashboard cigarette lighter. It may be converted quickly to house current, battery, or LP gas. It's small enough to fit in a car or boat, keeps 25 pounds of food. Selectra Industries, Ltd., 22 Dorchester Ave., Toronto, Ont.



WHAT'S

Cut-Off Switch Blocks Car Fire

Here's a switch that will shut off your motor and prevent a fire if your car upsets. It's installed on a battery post and has a connection for the cable, and a field wire that puts it in series with the voltage regulator and generator. Two columns of mercury make contact, but run out if the switch is displaced. Once broken, the contact can't be made again except by returning the mercury to position with manual resetting. \$17.95. Paul Brown Fyre-Blok Sales, Inc., Chesapeake, Ohio.





MERCURY IN SWITCH makes electrical connection when battery is upright (left); breaks it when

turned to either side (center), upside down (right), and even back over again to upright.

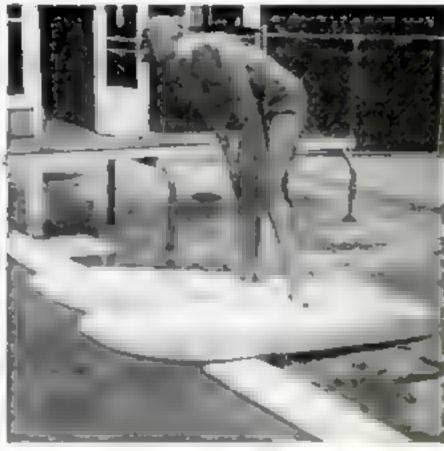




WOOD-INLAY MAP shows each of the 48 continental states in a different kind of veneer, precut to shape, from mottled aspen (Kentucky) to walnut burl (New Hampshire). A reverse-printed 13¾-by-22-inch map is furnished for facedown assembly, simplifying gluing. The kit costs \$11.95. Albert Constantine & Son, Inc., 2050 Eastchester Rd., NYC.

STEEL RULE has an open-face dial with a hairline guide on top of its case for easy direct reading of inside measurements. The 78-inch rule is accurately printed in black and white on flexible tempered steel. Its case is made of hylon, said to be virtually unbreakable. Price. \$1.50. Industrial Product Sales Co., 1182 Broadway, NYC.





CAMPING TRAILER opens into an eight-by-11-foot tent. It contains two three-quarter innerspring beds on a center aisle and is protected by an armyduck top, rain flaps, and nylon screen on an aluminum frame. There is 50 cubic feet of storage space under the beds. When folded, the Nimrod is 40 inches high, five feet wide. Ward Mfg. Co., 2530 Spring Grove Ave., Cincinnati

WATER SHOES make it easy to walk or play on top of the water. They are molded of buoyant cell-foam polystyrene and coated with abrasive-resistant plastic. Each shoe is held to the foot with an adjustable clastic neoprene harness. They can be used for water polo, sailing with a hand-held sail, skiing, or as paddle boards. Water Shoes, Inc., 1807 Elmwood Ave., Buffalo, N. Y.





"END-FINDER" DISPENSER for cellophane tape has a pull-down, tear-off flap that keeps a finger-grip length of tape ready for use when opened. Closed, the flap seals the tape from exposure to air, dirt, and dust that cause cracking and splitting. It comes in two sizes: 800 inches, 69 cents; 1,296 inches, 98 cents. LePage's, Metuchen, N. J.

POWER PLANE combines the handiness of a normal plane with the speed and efficiency of a machine. Cutting depth of its 2%-inch blade can be adjusted from zero to 14 inch by a knurled screw on the front. Its universal AC-DC motor drives through gears sealed in an oil bath. Temperleys, Haslehust & Co., P. O. Box 548, Vancouver, B. C.



Carton Tip Shows Film Type

Form the habit of tucking the end of the film carton in your camera case. Then, even weeks later when you pick up the camera, you'll know what kind of film you loaded it with.—Thomas Crandall, Montreal, Can.



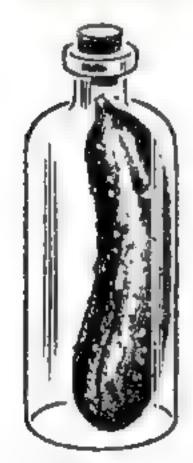
CHANNEL IROH BOIJ BOIJ

Lift-Out Fence Forms Gate

This lift-out gate is ideal for fence openings that are used only once in a while. As illustrated, two lengths of channel iron are bolted to the fence posts. A long bolt and a length of pipe make a bumper at the bottom of each channel. The gate thickness can be adjusted easily to fit the channel. Simply add furring strips of the necessary thickness.—Robert R. Livingston, Albany, N. Y.

Powell, Akron, Ohio.

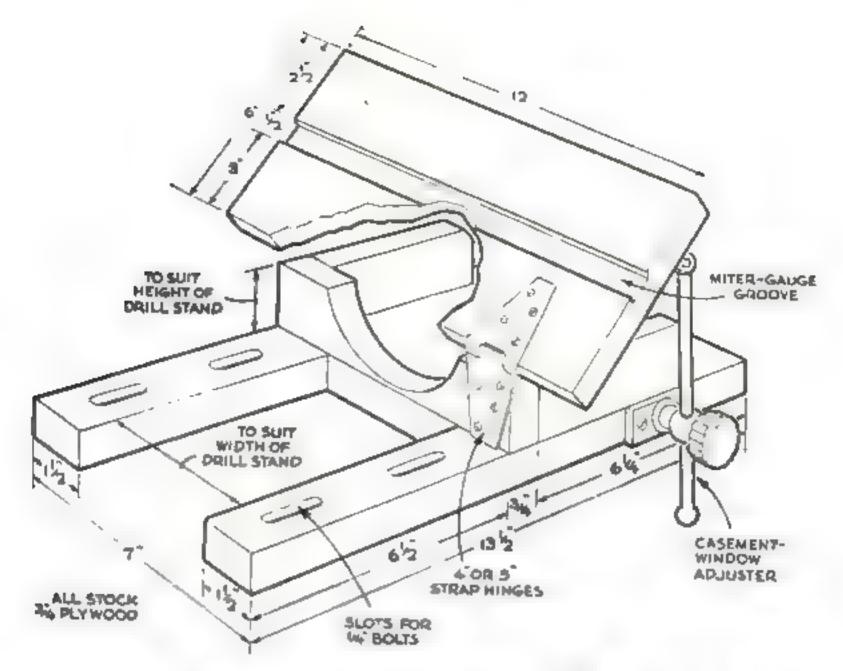
MASKING-TAPE initials will leave permanent identification on a growing pumpkin. Apply the tape when the fruit has attained full size but has not begun to ripen. Remove the tape from the ripe pumpkin to show the contrasting green initials.—S. G. Lasley, Queen City, Mo.



Here's How to Bottle a Cucumber Alive

Grow a big cucumber in a small bottle and you'll have a conversation stopper. Slip a glass bottle over a growing baby cucumber, and let it continue to grow, shaded by the leaves of the vine. When the cucumber nearly fills the bottle, detach it from the vine and preserve it by filling the bottle with brine.





How to build a Sanding Table for an Electric Drill

YOU can turn an electric drill into a versatile, accurate bench sander with this tilt-top table attachment. Made of scrap pieces of 3/4" plywood, it costs only a few dollars. Commercial tables sell for

many times more. With the table flat, you can smooth mitered cuts and square the ends or edges of rough stock. Tip the table up and you can sand long bevels or difficult compound angles. The table ad-

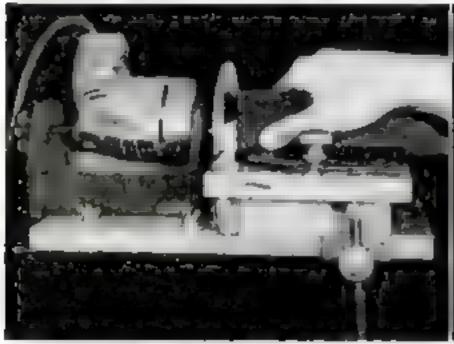
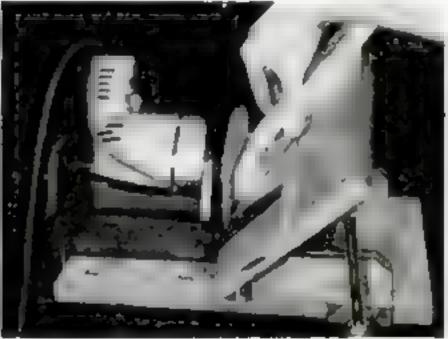


TABLE CAN BE USED PLAT for squaring stock and sanding miters or tilted up (above, right) for shaping compound miters and long bevels. A standard table-saw miter gauge can be used with the table level. As the table is raised, a corner of the miter gauge must be hacksawed



off or a smaller gauge used to keep it from striking the sanding disk. A handy-size gauge, shown at right, is the small type sold with drill-accessory kits. Table is clamped to the drill stand with bolts and wingnuts through slotted holes that permit precise adjustment.

justs from 90 degrees borizontal to al-

most 90 degrees vertical.

The table is designed for use with any of the standard metal bench stands that are available for most drills. The slotted end of the wood base must be cut to fit the particular drill stand you have. Otherwise, construction is simple if you follow three rules:

 Adjust the height of the table so it brings the work to the midpoint of the sanding disk for the most efficient smoothing. Since the most commonly used wood thicknesses are usually 1/2" to 3/4", this means locating the top of the table about 1/4" below the center of the disk. If you do a lot of work with thinner or thicker woods, alter the table height to suit.

Locate the hinged edge of the table

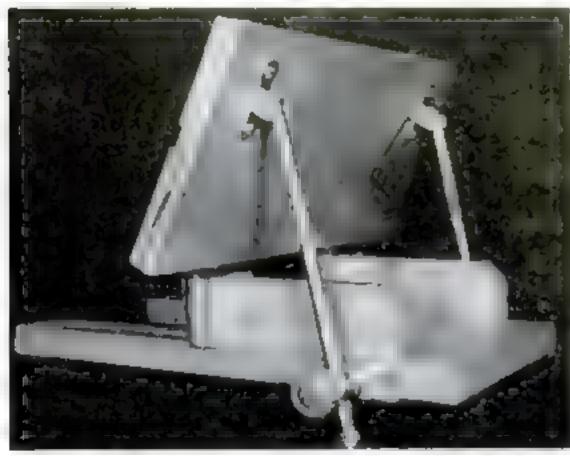


TABLE TILTS UP on easement-window adjusters. It locks at any angle by tightening knobs at sides. Unlike many tables, this one raises almost vertically for extremely sharp angles.



STRAP MINGES serve as pivots for the table. Ends are trimmed off as needed to clear base and miter-gauge slot. Semicircular cutout below table keeps sawdust from piling up.

as close to the face of the sanding disk as possible. This keeps the work from changing position as the table is tilted.

 Be sure to use the rigid, flat-faced type of sanding disk, not the flexible kind intended for hand sanding. A 5"-diameter disk is about the largest you should try to drive with a 1/4" or 3/8" drill. These can be bought either to fit into a drill chuck or to screw directly onto the shaft in place of the chuck. The type depends on your drill, Sandpaper disks are cemented on with a special adhesive.

The table is raised on two adjustable arms of the type used to fasten casement windows. These provide a simple, solid support without the fuss of making tricky quadrant brackets. Two ordinary strap hinges serve as pivots. These hinges,

normally a bit loose, are tightened by peening over the pins gently until they're snug. The rather odd arrangement of hinging the table at the top instead of the bottom edge is necessary to keep the table from tilting in against the sanding disk as it is raised. The hinges must be mortised into the top of the table to provide a flat surface.

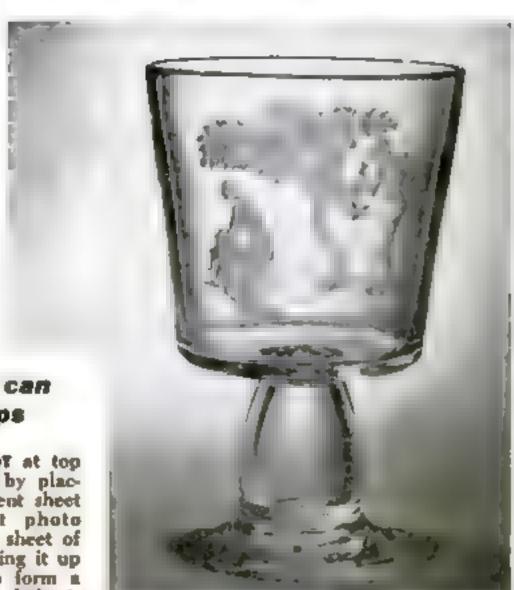
The table is grooved so that a miter gauge can be slid along it to feed the work accurately against the disk. The groove should be deep enough so that the miter-gauge bar rides in it without touching the bottom and just wide enough for a snugly sliding fit, Locate the groove parallel to the edge of the table next to the disk and far enough from it so that the miter gauge clears the disk by about 1/4".

In use, the table is set at 45 degrees by tilting it up against a try square placed against the sanding disk. Other angles can be determined by using an adjustable aquare or a draftsman's 30-60-90-degree triangle.— W. Herdman Schwatka Jr., Towson, Md.

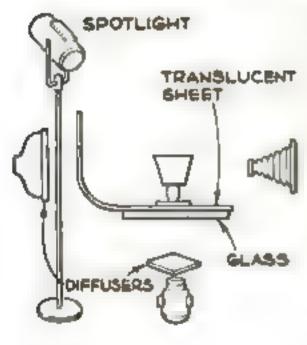
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The Tricky Art of Lighting Objects

Phers depend for their living on their ability to make simple objects look dramatic. How do they do it? You'll find the answers in a recently published Kodak Data Book, "Studio Lighting for Product Photography." It's available for 50 cents at photostores, How some of the problems are solved is shown on this and the following pages.



How totally different effects can be created with similar setups



HIGH-KEY SHOT at top right is made by placing a translucent sheet (available at photo stores) over a sheet of glass and curving it up at the rear to form a backdrop. One light is aimed up from below, while a second shines through from the back Note the complete absence of front lights the secret of elipmating annoying reflections



tom right is made with the same setup everpt that the back light is turned off. This produces a reversed in age effect of the eterings in the glass. Both shots are equally good, but show what can be done with slight variations in light ing arrangement. In both, the high back shot light is used to come light the rim of the show



How to photograph box-shaped objects

Try the squint test on these

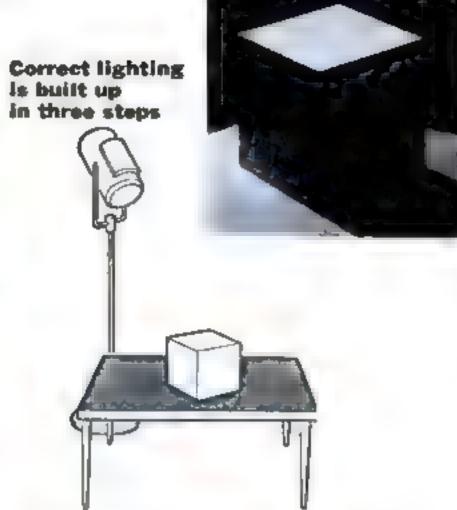
two photos. It will show you why they're bad

CUBE LOOKS FLAT when lighted only from the front because all sides receive equal illumination, destroying the effect of depth. Squint at the photo at right and you'll see that the cube loses its shape and becomes a hexagon.

BOUNCE LIGHTING isn't the answer either. This is the indoor equivalent of an overcast day. It provides enough top light, but does not distinguish between the cube's sides. The squint test still produces an undefined shape.

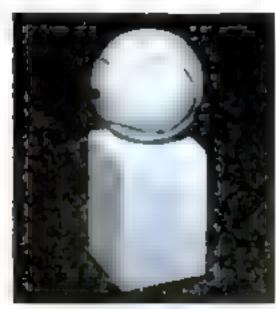




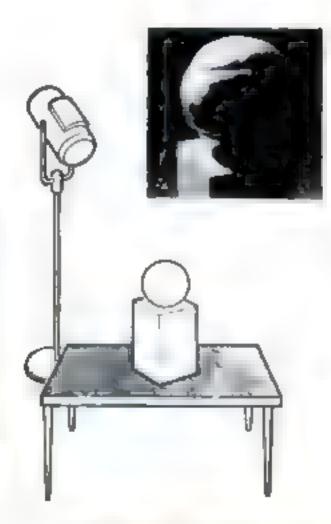


CUBE IS LIGHTED one surface at a time. First step is to get the strongest illumination on the top by placing the main light high and behind the cube. A spotlight is used to give a sharp beam.

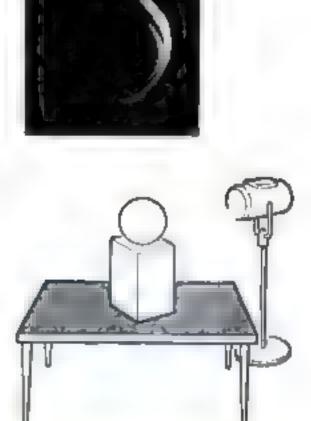
Back lighting is the secret to keeping a round object round



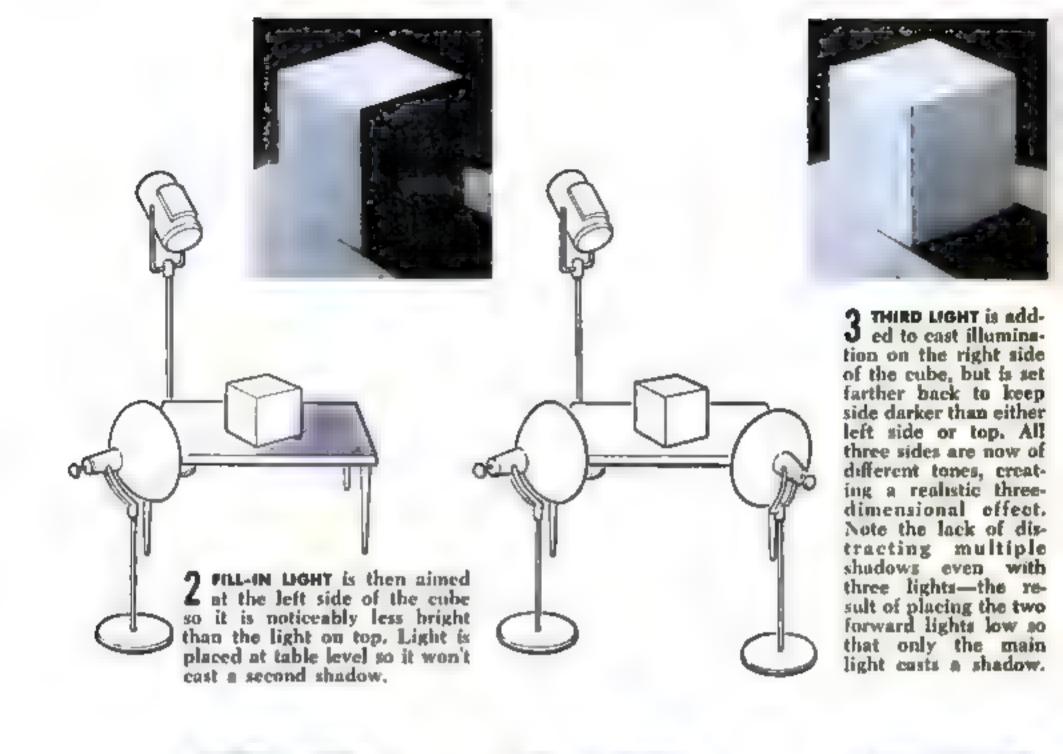
FRONT LIGHTING "sees" only the front part of this tennus hall, and thus has no way of distinguishing depth. You get the same flat result as with the front-lighted box shown above in top photo.

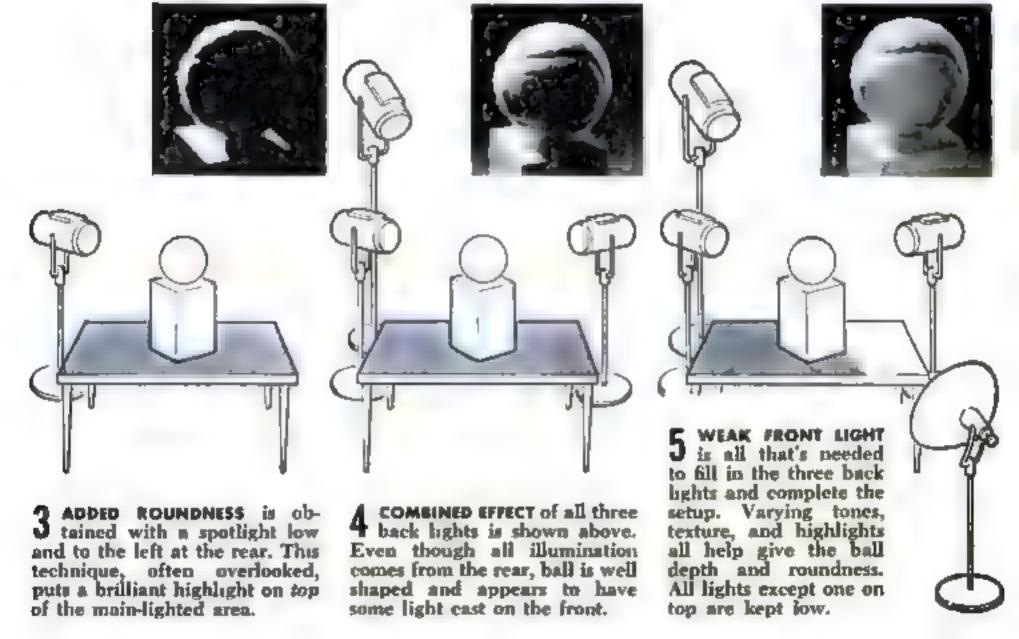


MAIN LIGHT is placed high, behind, and to the left of the ball to throw strong illumination on the top. Of the four lights used, this is the only one allowed to cast a shadow.

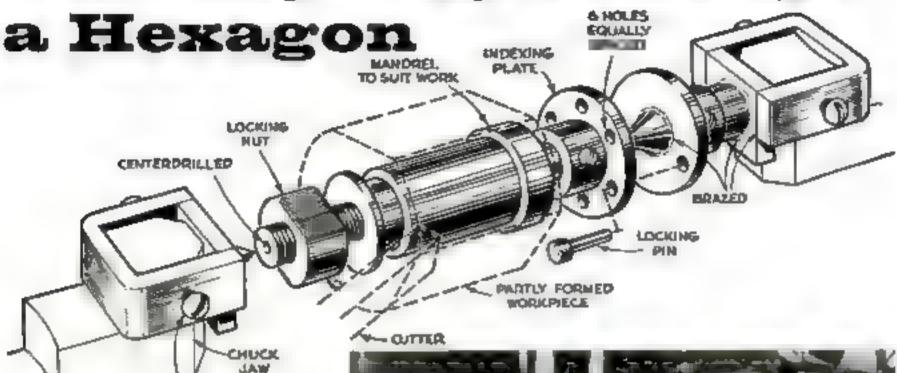


2 the right side by a second back light placed at about the ball's level. Note that while only a sliver shows, it already suggests roundness.





An Easy Way to Shape



notating round stock to each of six indexed positions produces a perfect hexagon. Easily made jigs fit regular four-jaw lathe chuck.

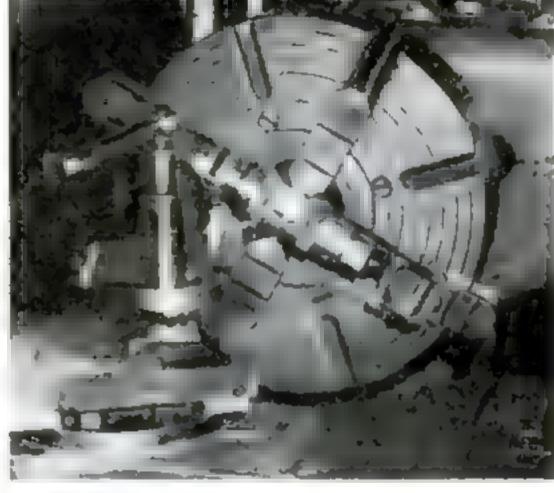
IN ANY small machine shop, you're likely to come across ingenious devices created by the machinist to overcome his tool shortage or to do a special job. This gadget, built by a Canadian machinist for shaping hexagons in a lathe, is a fine example of such ingenuity

It is a simple pair of holding and indexing jigs made to clamp over two jaws of a fourjaw lathe chuck. To make it, bend two U-shaped brackets of

1/4"-square steel to fit around the jaws, then braze a small rectangle of 1/1" plate to each bracket. Dimensions must be tailored to your chuck.

Turn two 60-degree centers and braze one to the face of each clamp. Over one center, braze a disk with a single indexing hole. Turn a matching disk with a hub to fit over the shank of a work-holding mandrel, and drill six equally spaced holes to align with the single hole in the fixed disk. Turn a snug-fitting pin to lock the two disks together. Varying the number of holes in the mandrel disk lets you index four or more sides for shaping aquares or other multi-sided pieces.

To produce a hex or other shape from round stock, lock the jigs on the chuck iaws. Slip the stock on the mandrel and



lock it with the nut on one end (mandrels of various diameters may be needed for different jobs). Place the mandrel between the centers and tighten the chuck jaws to secure it. Place the locking pin in the first indexing hole and tighten the two free jaws lightly against the sides of the stock.

Turn on the lathe and use a facing tool to face the first flat side on the stock. Use a carriage stop and set the compound parallel with the lathe bed so you can advance the facing tool the same amount each time the work is rotated and indexed in a new position.

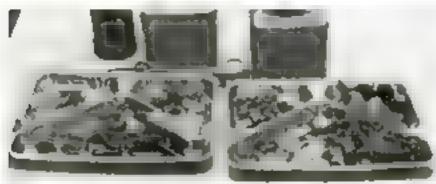
The resulting hexagon with flat aides and circular highlights is far superior to one formed by filing.—Lloyd McWilliams, Shawingan Falls, Quebec.





An Easy Way to Cut Insulation

A BLADE assembly salvaged from a junked paper cutter makes an ideal tool for cutting insulation.—
David A. Cleary, Fargo, N. D.



Uses for TV-Dinner Plates

Don't discard those aluminum plates that TV dinners come in. They make handy sorting trays for the workshop. In the photo they are being used to check and distribute parts from an electronic construction kit. You also can put them into service for mixing small amounts of paint or cleaning small parts.—H. M. Daeidson Ir., Daytona Heach, Fla.

Filling Vacuum Bottles

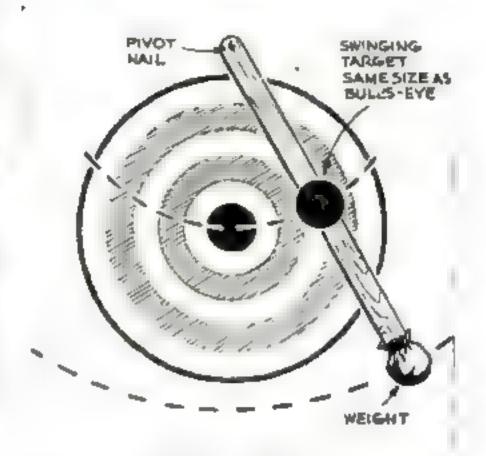
Do you have overflow trouble when filling your vacuum bottle? You can prevent



it with this simple trick. Drop a plastic fishing bobber (the long, slender kind) into the jug. Then fill it. When the bobber floats at the neck, the vacuum bottle is full. John B hitney, Baltimore,

Magazine-Page Holder

When tackling a workshop project from a magazine, keeping flat the page you are working from is often a problem. The mousetrap page holder shown in the photo is a simple answer. First remove the trigger and bait hook with a pair of pliers.—Ril Toman, l'alatine, Ill.



Swinging Bull's-Eye Target

You'll find a swinging bull's-eye on your dart board or archery target more fun—and a real test of skill. Cut the pendulum from cardboard or thin wood, and hang it on a pivot nail so that the moving eye cuts exactly across the fixed one. To keep it swinging longer, attach a weight (a cloth bag filled with shot is good) that clears the bottom of the target. Pierce both bull's-eyes with one dart or arrow, and you're a real marksman.—
W. G. Wilhite, Carlinville, Ill.





Making a Model Air Sled



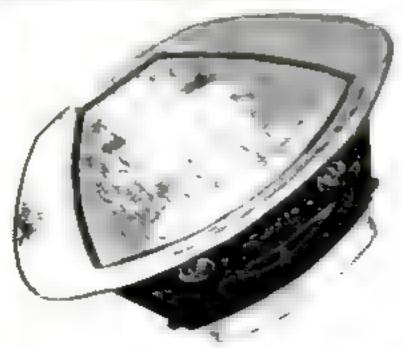
By Harry Walton

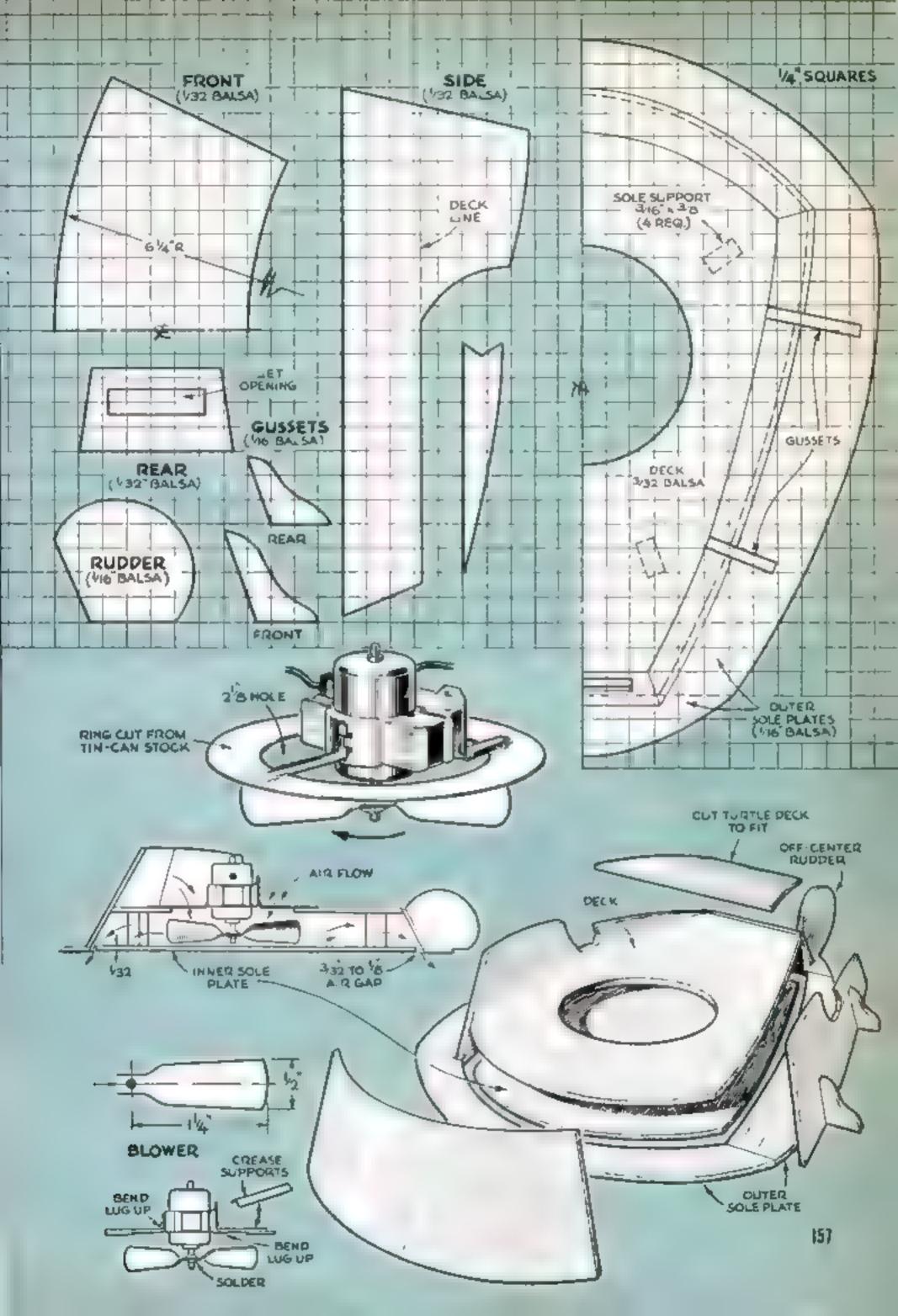
I OTTEST news in vehicles is the air sled, a wheel-less wonder that skims on a cushion of air. Want to see one work? This model scoots around on wood, linoleum, or tile floors, smooth concrete, or asphalt, at a pace to keep the tether-line pilot on his toes.

You can make it in a couple of evenings for about five dollars—including economy-size batteries—and have 50 dollars' worth of fun.

First, cut out the main deck. Lay it on an \(\frac{1}{4}\)"-thick block, and glue on the sides at the sheer angle shown, their bottom edges overhanging the block to touch the work surfaces. Lay out the front with the grain running the short way. Cement it to the deck and sides, its bottom edge flush with those of the sides. Cut the jet

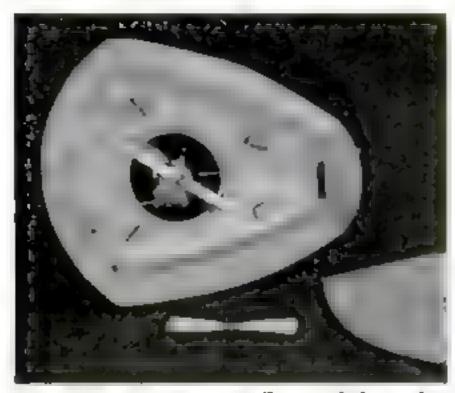
SLED SKIMS ON AIR that escapes from a 3/32"wide slot all around the underside of the body.
The inner sole plate is inset slightly. At rest,
only the outer plates touch the ground.



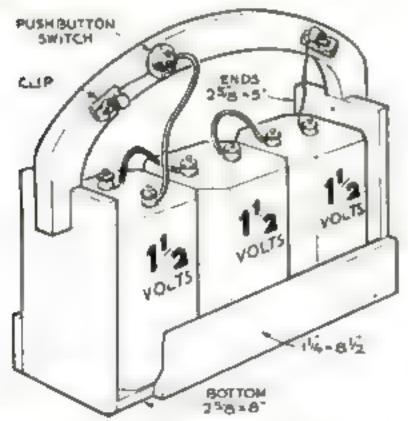




CEMENT THE MOTOR on its ring mount to the top of the deck, as above. Bring one wire out of a hole at the front. Cement the other at the rear before you mount the turtle deck.



check stade cutanance all around the underside of the deck, then again with the inner sole plate held against the blocks. Bend the propeller blades as necessary for free action.



BUILD THE BATTERY BACK to hold two or three dry cells according to the permissible motor voltage. A heavier motor may require three cells and a slightly larger propeller as well.

opening in the rear panel before cementing that piece in place.

Make outer sole plates with the grain lengthwise. Cement them under the body walls. Then sandpaper the plate edges flush on the inside to insure that there is a free air flow.

Lift and propulsion. Power is derived from a tiny permanent-magnet motor. Trace the propeller pattern on paper and glue it to timplate. Cut and file to shape, then solder the prop directly to the motor shaft.

Bend each blade around a %" rod. Twist both with the concave face down at a fairly steep pitch angle. Mount the motor on the tinplate ring with creased struts soldered into the base holes and one tab. Clean the ring with dope thinner, apply cement, and center it over the deck opening.

Air must blast out of a slot all around the bottom. Lay thin paper across the sole plates and run a finger around the inside edges to obtain a pattern. Cut an inner sole plate to a contour "" inside this.

Cement four small blocks under the deck where they will not interfere with the prop. Make them short enough to inset the plate by \(\frac{1}{2} \)".

Motor torque tends to spin the airpoised body opposite to prop rotation.
Mount the rudder parallel to one side so
as to counteract this—at the left side,
if the prop spins clockwise seen from
the top.

Trim and details. These can be added from any model-car kit after the body is doped. Seats of thin balsa can be covered with leather cut from a discarded glove.

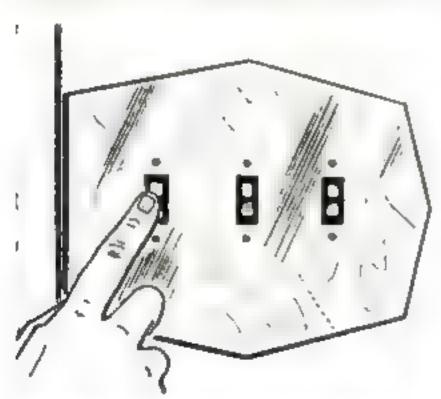
Solder the motor leads to No. 30 stranded phonograph pickup cord, bringing one wire out at the front and one at the rear as a control bridle. Depending on the motor used, the sled will work on three or four fresh D cells, but square 1½-volt cells of the kind used for starting glow-plug engines last longer, and two are as lively as three of the flashlight variety.

A battery rack that leaves one hand free to guide the sled is shown at the left. A freely working pylon with rotating contacts would serve as well. Hook up the battery so that the prop blows downward, and you're ready for takeoff.



Mending Auto Upholstery

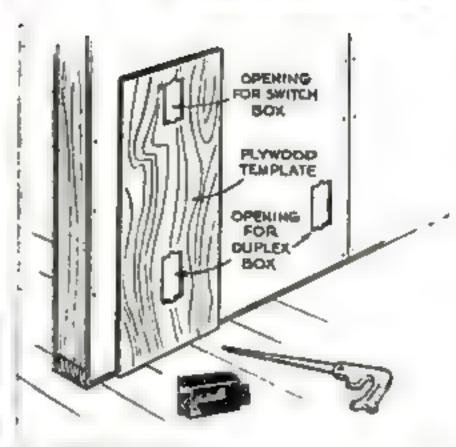
IRON-ON mending patches provide a quick and easy method of repairing small tears or punctures in auto upholstery. Choose a matching color, and heat-stick in place.—M. C. Anderson, Arlington, Va.



Cutting Counter-Top Plastic

I MADE wall-switch cover plates from y'a" counter-top plastic. The big trick is learning to cut the switch holes; I've found that tracing their outlines with a carbide glass cutter first makes it easy. You can then saw them out with a spiral saw blade in a coping-saw frame.—Herbert E. Serold, New Braunfels, Tex.





Template for Outlet Holes

To speed roughing-in electrical outlet and switch boxes in dry walls, one electrician made a plywood template to give him standard shape and location for the holes.—Vincent Lawrence, Albany, N. Y.



Motor Used as Arbor

A BURNED-OUT motor—if it has a double-ended shaft—may still serve as an arbor for a jackshaft or a large fan.—
David A. Cleary, Forgo, N. D.

WHEN filing aluminum, keep the file from loading by dipping it repeatedly in kerosene.—Joseph Whitehill, Easton, Md.

Power Lift for a Radial-Arm Saw

TERE'S a novel way to put an electric drill to use even when it's in storage. Clamp it to the top of a radial-arm saw, gear it to the hand crank, and you have a power lift to raise and lower the saw.

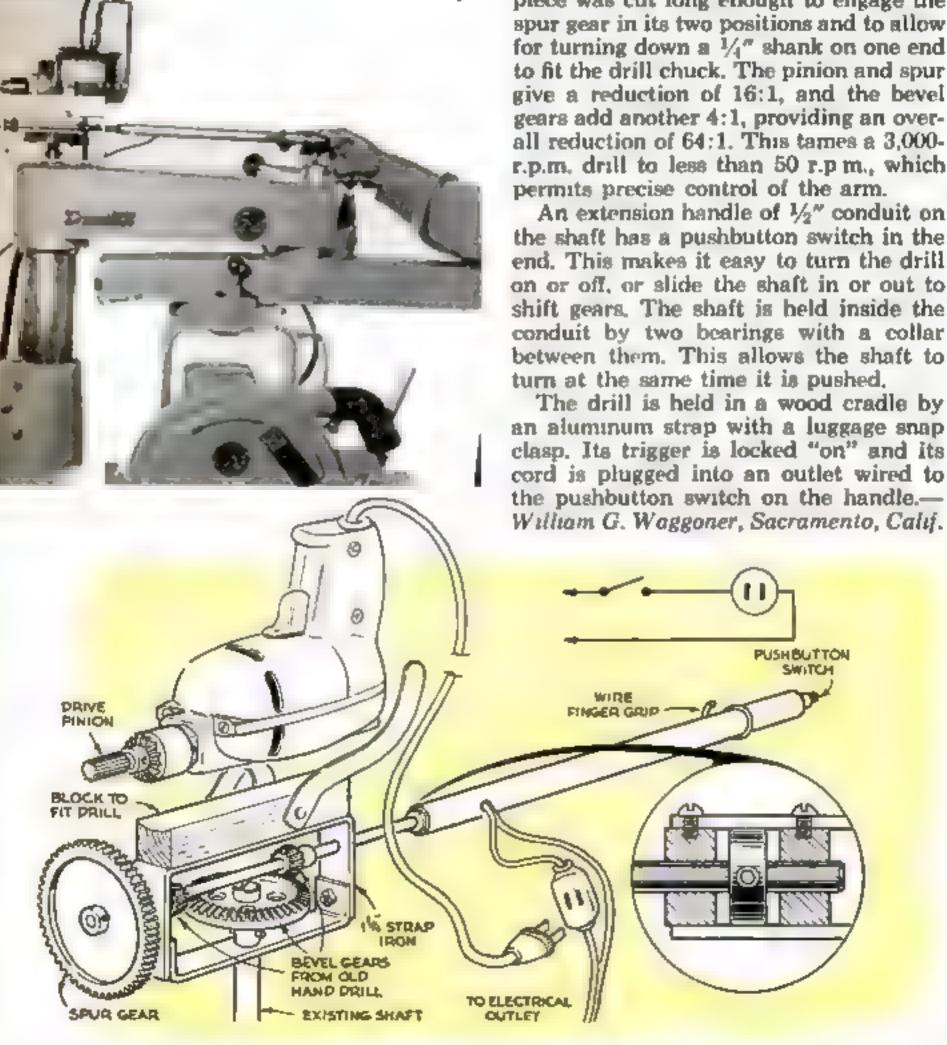
The three bevel gears I used were salvaged from an old hand drill. They are mounted in a strap-iron frame, with the

large gear replacing the original crank. The two small gears are arranged on a shaft that can be slid forward or back to engage either one of them with the large gear. Engaging one gear raises the saw: engaging the other reverses the drive and lowers the saw.

Only two parts had to be bought—the spur gear that goes on the outer end of the shaft and the pinion gear that fits in the drill. From a 1' section of pinion, a piece was cut long enough to engage the spur gear in its two positions and to allow for turning down a 1/4" shank on one end to fit the drill chuck. The pinion and spur give a reduction of 16:1, and the bevel gears add another 4:1, providing an overall reduction of 64:1. This tames a 3,000r.p.m. drill to less than 50 r.p.m., which permits precise control of the arm.

An extension handle of 1/2" conduit on the shaft has a pushbutton switch in the end. This makes it easy to turn the drill on or off, or slide the shaft in or out to shift gears. The shaft is held inside the conduit by two bearings with a collar between them. This allows the shaft to turn at the same time it is pushed,

an aluminum strap with a luggage snap clasp. Its trigger is locked "on" and its cord is plugged into an outlet wired to the pushbutton switch on the handle.— William G. Waggoner, Sacramento, Calif.





Here's a fast and easy way to do a tedious chore:

Cleaning Paint from **House Shutters**

TRIPPING old paint off louvered shutters is such an impossible chore J that it seldom gets done. Since you have to use non-chalking paint on shutters to keep them from staining the house. the old layers build up year after year, spoiling each new paint job by causing it to crack, peel, and wrinkle.

But there is a way to solve the problem. You can follow the example of four Connecticut families who got together and dipped their paint-caked shutters and other pieces of furniture into a bath of lye. The lye took off all the paint right down to the bare wood. In a single weekend, they completely cleaned 130 shutters, six doors, two chairs, two tables, and a bureau. Total cost for chemicals and equipment came to less than \$30-only about \$7 a family.

While lye can cause serious burns, it need not be hazardous if you take precautions. Goggles and rubber gloves are a must at all times when you are working with the chemical or standing where it

AFTER

BEFORE -

might splash on you. Building a back-yard tank, The main trick in handling lye is to have a tank big enough to hold shutters and bulky pieces of furniture so they can be completely covered by the chemical. The tank built by the Connecticut home owners is nothing more than a wood form, set directly on the ground, with a liner to make it liquid-tight, Tongue-and-groove boards cleated together form the sides. It is large enough—8' long, 4' wide, and 151/2" deep-to hold two rows of shutters six deep-or a total of 12 shutters at a

For strength, the tank is lined with strips of inexpensive roll roofing curved up the sides of the boards and stapled at the top. This is then covered with a 9'by-12' sheet of six-mil polyethylene, which provides a tough, leakproof bottom that's unaffected by the caustic action of the lye. This temporary tank takes only

How to make a safe, inexpensive tank to hold the lye



shearning moands, braced by two-by-fours, form the walls of the tank. The extra board nailed across the outside of the two-by-fours strengthens the sides against bowing outward.



TANK 15 LINED with strips of 43-pound roll roofing backed up by earth where it curves up the sides. The joints are scaled with roofing coment, and edges are stapled at the top.



POLYETHYLENE SHEET provides a water- and chemical-proof bottom. As the tank is filled, the plastic is smoothed out, pulled up the sides, and stapled to the top of the boards.

LYE IS SHOVELED into the tank, never touched by band. Coggles and rubber gloves are a must for safety. For a tank this size—8' long, 4' wide, 151/2" deep—entire 100-lb. drum is used.

half an hour to set up and a few minutes to knock apart when you're finished with it.

Sonking the shutters. The tank is filled part way with water, and the lye is then added in the form of dry flakes. You can get the lye (often called caustic soda) in 100-pound drums. For a tank of the size described here, the entire drum is used.

The shutters are stacked in the tank, and the rest of the water is added until the solution completely covers them. Keep sharp-edged hardware from touching the bottom directly or it may puncture the polyethylene sheet.

Since wood floats, it's necessary to

hold down the shutters while they're in the tank. A wood frame tied across the top of the tank presses downward and keeps the shutters submerged. Spacer strips are inserted between the layers of shutters to separate them and allow the chemical to circulate. These are made by ripping wood strips at a 45-degree angle on a table saw to produce long sticks with a triangular cross section.

Rinsing off the paint. When the lye is fresh, it takes only about 30 minutes to do each batch of shutters. As the chemical weakens, the process takes longer. The Connecticut experimenters used the same solution throughout and found that by the end of the weekend the shutters

Soaking and rinsing removes old paint in half an hour



SHUTTERS ARE STACKED in the tank six deep in two rows. To keep them from floating to the surface, a wood rack is pressed down on top and tied to the sides of the tank. Two boards

nailed edgewise under the rack protrude into the live and hold the shutters down. After half an hour, the shutters are taken out and hosed off to remove the loosened paint.



A SECOND BATH, this time in muriatic acid, neutralizes the lye so that the wood can be repainted. The same tank is used, but must be thoroughly washed out to remove the lye.

FINAL HOSING removes the neid, leaving the shutters bare and clean. Shutters should be stood upright where air can get at them and allowed to dry two weeks before painting.

had to be left in over an hour before the paint came off.

As each shutter is removed from the tank, it is washed off with a strong stream from a garden hose. In most cases, this completely removes the loosened paint. In a few hard-caked spots, it may be necessary to use a scrub brush or putty knife to scrape off the paint.

The washing produces a white froth that looks like soap suds. The shutters must be thoroughly rinsed until all traces of these suds disappear.

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After all shutters have been bathed and rinsed, the tank is emptied, washed clean, and refilled with water. A gallon of muriatic acid is added to the water.

and the shutters are sonked in this acid solution for five minutes to neutralize the lye. Unless the lye is neutralized, new paint will not hold well.

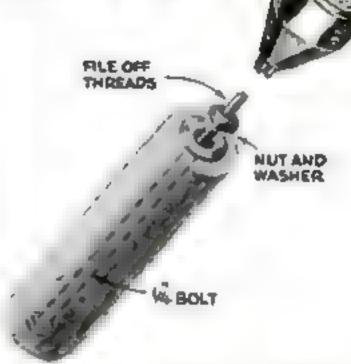
After this bath, the shutters are given a second hosing to remove the acid. Before painting, it's best to wait at least two weeks to be sure the shutters are absolutely dry.

Since the caustic solution is still strong after it's used, it must be emptied into a storm sewer, dry well, or other safe place—not into house plumbing or on the ground where children or pets might get into it. The chemical must also be kept away from flowers and plants to avoid damage to them.

PAINTING HINTS



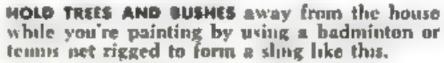
MINGS THAT TRELLIS if you'll have to paint behind it. It makes the trellis easier to refinsh, too. Attach it with brass hinges to the top of two-by-fours coated with preservative and driven into the ground. Screen-door books hold the top against backstops at each end.



SPIN A ROLLER CLEAN by running a long 1/4" bolt or length of threaded rod through it and chucking it in an electric drill or drill press. Hold an old pail over it to catch the spray.

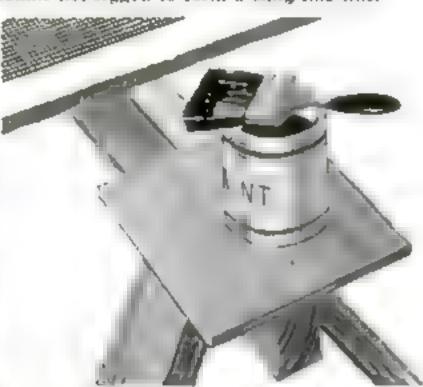


LINE ROLLER TRAYS with polyethylene film. It saves a messy clean-up job and the stuff won t slip or puncture as other liners often do.





PROTECT BUSHES OR FURNITURE with dropcloths of four- or six-mil polyethylene. It's strong, light, comes in big sheets, and won't soak up paint and become soggy as ordinary cloth will.



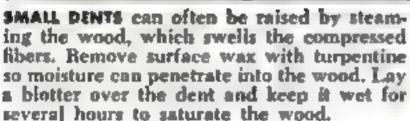
TACK A SMALL PLATFORM to one end of a sawhorse when you're using a pair of horses to paint on. The shelf will hold the can within easy reach and keep it from tipping.

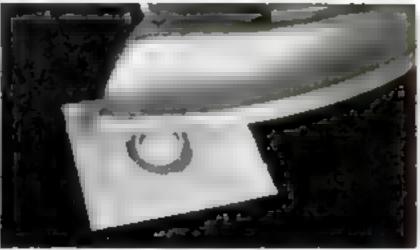
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Making Surface Repairs to Fine Furniture

How to smooth a dent with steam





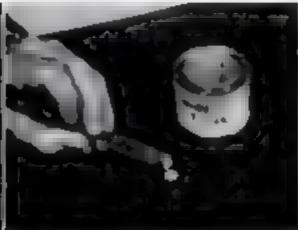


APPLY HEAT to the dent with an iron. Lay a metal bottle cap over the blotter. This concentrates the heat, steaming the dent. If the dent won't swell, remove the finish and try steaming again. If this won't work, use the filling method described for deep scratches.

How to fill in and hide a cigarette burn



CLEAN OUT THE BURN thoroughly, scraping away all damaged fibers with a knife edge or razor blade. Then smooth the wood with a small piece of fine sandpaper or steel wool, feathering the edges into the good wood.



FILL DEEP SCARS with a wood paste filler until the recess is almost flush with the surrounding surface. Shallow burns can be built up with coats of varnish or shellac. depending on furniture's finish, without the filler.



MASK THE AREA around the burn with tape. Cover the filler with stick shellac in a color to match the furniture. Melt the shellac in a flame and smooth it on. Remove the tape and shave the shellae flush with a razor blade.

How to attach loosened veneer

MOISTEN LOOSE VENEER with SQUIRT GLUE under the vea damp sponge to soften it, then lift it gently and scrape out old glue underneath. If the veneer is badly warped, steam it with an iron over a damp cloth to straighten it.

neer with a long applicator pozzle like this. If nozzle won't reach, work the glue in with a blade or wire. Press the veneer down firmly and wipe off excest glue.

with a clamp or stack of books until the glue dries. Put wax paper down first to prevent the glue from sticking, then a wood block to pad the jaws of the clamp.







How to hide a scratch



FINE SCRATCHES can be removed by softening the finish and letting it flow together. Use alcohol for shellac, turpentine for varnish, lacquer thinner for lacquer. Dab the solvent on with a fine artist's brush.

WHERE THE STAIN IS DAMAGED, it can be restored with fine-tipped touch-up applicators that come in many colors. Dark woods also respond to repeated rubbing with walnut meat, liquid shoe polish, or stain waxes.



A TEMPORARY REPAIR for a scratch can be made with a crayon in a color to match the finish. Rub in, clean off the excess, then polish with wax. This works especially well on enamel.

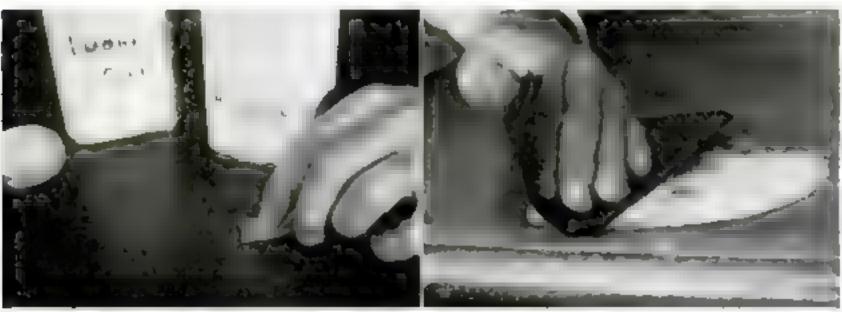


FILL DEEP SCRATCHES with stick shellae in the same way as for burns. Build up the shellae to the height of the masking tape, then shave it down with a razor blade and polish with fine purifice.



TO RESTORE A FINISH that's been removed in the process of repairing a scratch, use spray cans of lacquer, shellac, or varnish to match the finish. Smooth with rottenstone in oil, then wax.

How to eliminate various blemishes



WHITE RINGS usually call for removing the top layer of finish. Do this with alcohol, turps, or lacquer thinner depending on the finish. Then try rubbing with rottenstone in oil, camphorated oil, or linseed oil until the ring disappears. Then restore the finish.

STAINS AND SPOTS made by cosmetics, ink, candle wax, and milk will disappear after a vigorous rubbing with cream wax. Use a felt pad and rub in the direction of the grain. Small spots can be touched up with a dab of camphorated oil left on for balf an hour.

What You materials Should Know About PLASTIC PIPE

PIPE made of light-weight, easy-to-handle plastic is finding its way into more and more home plumbing systems—and for good reasons:

 It is low in cost—as low as galvanized pipe and less even than copper in most cases.

 It won't rot, rust, or corrode, even when buried underground.

 It is so light that you can hold in one hand a coil big enough for a fair-size plumbing job.

 It comes in long, onepiece lengths so you have very few joints and fittings to fuss with.

 It is easy to work with because you need no pipethreading equipment, cutters, reamers, or other special tools.

These advantages add up to money in the bank if you do your own work. In most cases, you'll be able to use the flexible kind of plastic, which means you can easily curve it around obstructions and run it through walls in one unbroken length. If you have a plumber do the job, you'll also save because plastic pipe takes so much less time, labor, and tools to install.

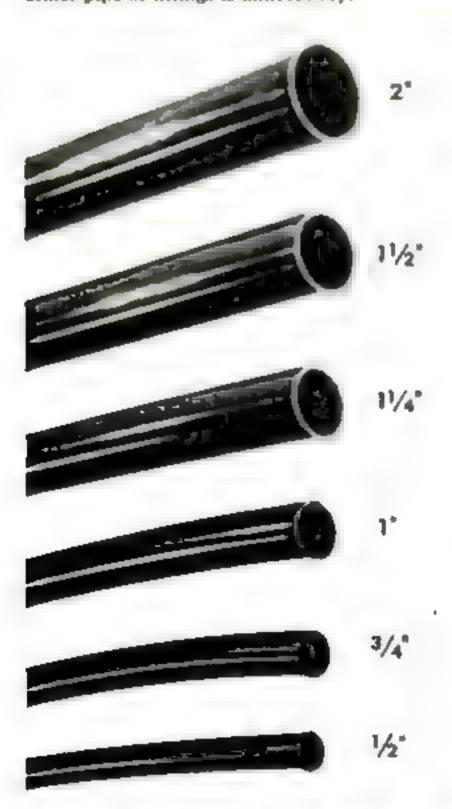
For cold scater only. At present, plastic pipe is suitable only for cold-water lines. Most brands cannot



EASY TO HANDLE: This 100-foot coil of ¾" plastic pipe weighs only about 11 pounds. The same length of ¾" galvanized metal pipe would tip the scales at close to 95 pounds.



EASY TO WORK WITH: All you need is a sharp knife to cut flexible plastic pipe wherever you want to end a line or add a fitting. Threading of either pipe or fittings is unnecessary.



MOST WIDELY USED SIZES of flexible plastic pipe range from 1/4" diameter up to 2". Of these, the two smallest-1/2" and "4"-handle most jobs around the home. Next larger 1" size is sometimes used for wells and main feed lines of underground lawn-sprinkler systems.

be used where temperatures will exceed 140 degrees, although a few are rated as high as 160 degrees. This eliminates them from use in household hot-water systems because, even if your hot water were set to cut off below this temperature, there would not be enough of a safety factor

New types of plastic are being developed, however, that promise some day to make possible a pipe capable of withstanding temperatures up to 300 degrees. With this, the house with all-plastic plumbing will finally become a reality

One benefit you don't have to wait for is plastic pipe's great amouthness on the inside. This means much less tendency for sediment to accumulate and less loss of pressure because of friction. For this reason, any given size of plastic pipe will deliver more gallons per minute than its equivalent size in metal pipe.

New standards make buying easy. It used to be, when you went shopping for plastic pipe, that you could never be sure exactly what you would get. Standards varied considerably from one manufacturer to another and many pipes were not

suitable for drinking water.

Now this has changed. Most of the better-quality plastic pipes are approved by the National Sanitation Foundation as suitable for drinking water. Commercial standards have also been established for various types of pipe by the U.S. Department of Commerce.

You can be sure you're getting pipe that meets these standards by looking for the National Sanitation Foundation (NSF) seal and the tag or label that indicates that the pipe conforms to the ap-

propriate commercial standard.

Types of plastic pipe. Except for some specialized industrial kinds, practically all mass-produced plastic pipe falls into one of four major categories: 1) polyethylene; 2) ABS (short for acrylonitrilebutadiene-styrene); 3) PVC (polyvinylchloride); and 4) Butyrate (cellulose acetate).

Of these, only two are likely to be used around the home—polyethylene and ABS. Polyethylene is the only one made in flexible form and is by far the most popular, accounting for about 75 percent of all sales.

Polyethylene is the lightest and the cheapest of all. You can buy the flexible kind in coils up to 200' long and in some

cases in longer lengths up to 400'. Hard-ware dealers and plumbing-supply houses sell it by the foot in ½" to 2" diameters. Larger sizes, up to about 3", are classified as semi-rigid and are sold in straight lengths rather than in coils.

A new high-density type is also available. This is usually in rigid form and can withstand higher working pressures

and temperatures,

The fittings. To cut flexible plastic pipe all you need is a sharp knife or a fine-tooth saw. For joining two lengths or splicing in branch lines, special molded fittings are available. These come in the same general types and shapes as regular plumbing fittings except that they require no threading. You simply slip the fitting into the plastic pipe and tighten a metal clamp around it with a screwdriver.

To connect a new plastic line into existing plumbing, you use adaptor fittings that match the plastic pipe on one end and standard iron or copper pipe on the

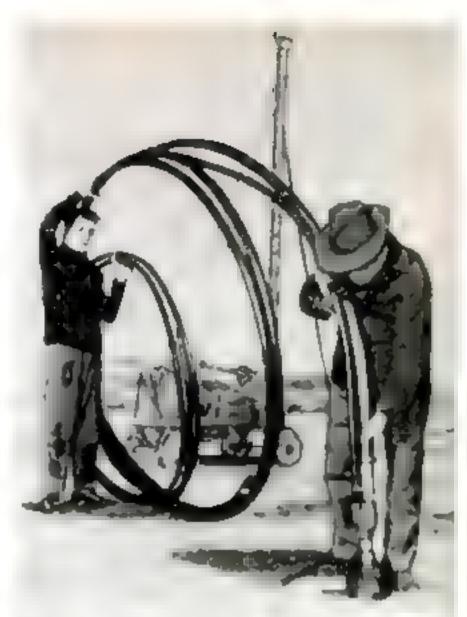
other end.

Plastic pipe is widely used in running underground lines for lawn-sprinkling systems because the plastic is unaffected by either moisture or freezing. For this, you can get another kind of adaptor fitting that connects the plastic pipe directly to the garden-hose threads on outside faucets.

You'll also find flexible pipe ideal for running water to a terrace or pool or for installing your own outdoor drinking fountain or shower. In winter, there's no need to worry about draining the lines—the plastic just expands slightly as the water freezes. Another advantage of this kind of pipe for underground installation: You can assemble an entire line, complete with fittings, test it, then simply roll it into a trench.

Flexible pipe has practically cornered the market on jet-well installations. It can be lowered down a hole without hoists or other equipment, and the one-piece lengths eliminate stopping every 10' or 15' to hook on new sections of heavy metal pipe. For wells that require two pipes, a special twin-tube version is available. Another type, made especially for submersible pumps, has a built-in steel cable to support the weight in deep wells and prevent stretching of the plastic.

Rigid pipes. Three types of plastic are also available in rigid form. These are



PLASTIC PIPE FOR WELLS enables one man to lower an entire line in a few minutes without hoists or other special equipment. Up to 200 feet can be put down at a time without stopping to add new sections, as with metal pipe.

ABS, PVC, and Butyrate. Of these, the ABS type is the only one used to any great extent around the home. It withstands higher pressures and temperatures than the flexible kind and comes in larger sizes—up to 6" in diameter.

Rigid pipe is mainly useful where you need straight lengths that will support themselves without bending or sagging. It is excellent, for instance, for running drain lines to dry wells or around foundation walls where a constant slope is required—not possible with flexible pipe. A special perforated type, with ½" holes at 5" intervals, can be used instead of conventional drain tile and is easier to install

Unlike flexible pipe, the rigid kind is assembled with plastic cements that produce a virtually solid, welded joint between sections. The result is an absolutely watertight, leakproof line with no possible openings for tree roots to penetrate. This makes rigid pipe ideal for sewer lines to septic tanks. In some communities, it is also used to connect water mains to houses and for carrying natural gas.

As with flexible pipe, commercial standards have been established for rigid ABS by the U. S. Department of Commerce. Many brands have also been approved for carrying drinking water by the National Sanitation Foundation, and those that are approved bear the NSF seal.

Electrical conduit. In addition to its plumbing jobs, rigid plastic pipe is also made in special types for use as electrical conduit.

Both heavy- and thin-walled varieties are available, and both can be used with standard slip fittings, junction boxes, and lock nuts.

The conduit is made in diameters from \\\2" to 6" and is much quicker to install than conventional metal types. You will never have to worry about its rusting, even when it is buried in damp ground or embedded in concrete.

What about building codes? Many codes were written long before plastic pipe was even thought of, so there may



LOOK FOR THIS SEAL when you buy plastic pipe. It tells you that the pipe is certified by the National Sanitation Foundation as safe for drinking water. Not all kinds are.

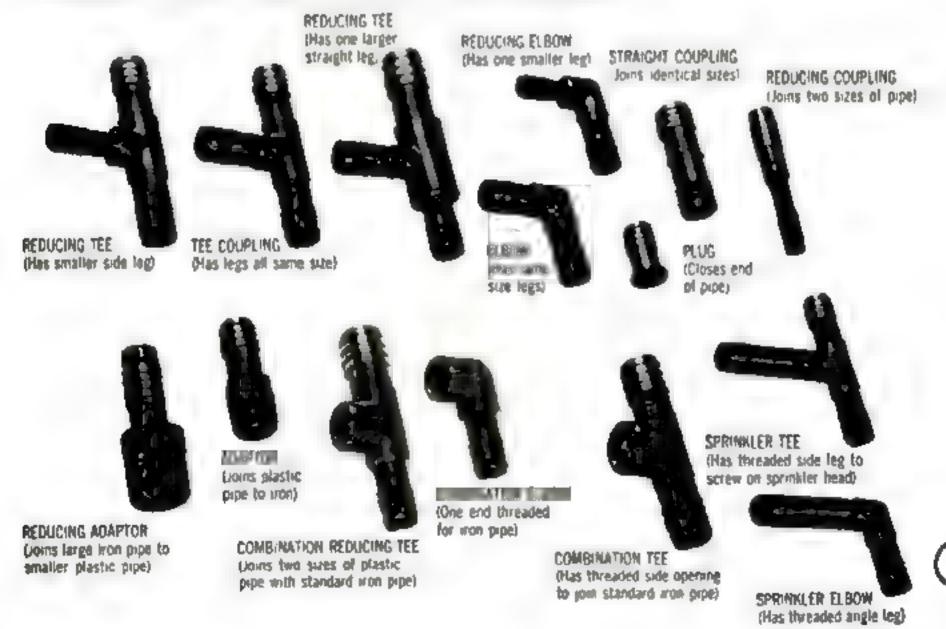
be a question if you want to use the pipe inside your home. Some codes permit its use without actually approving it, while others don't mention it one way or the other.

Few codes, if any, forbid the use of plastic pipe for extending water lines around the outside of a house or in detached garages, workshops, and similar non-dwelling areas. For inside use, it's best to check first with your local build-

ing department, especially if you live in a large city.

The use of plastic pipe for wells is so widespread nowadays that it is permitted by most codes. You may not find the same to be true, however, of electrical conduit and gas lines. The codes governing these uses are inclined to be conservative and very strict in some areas. But again, to be on the safe side, check with local authorities before using plastic pipe for anything other than around-the-yard jobs.

Fittings you can buy for flexible plastic pipe

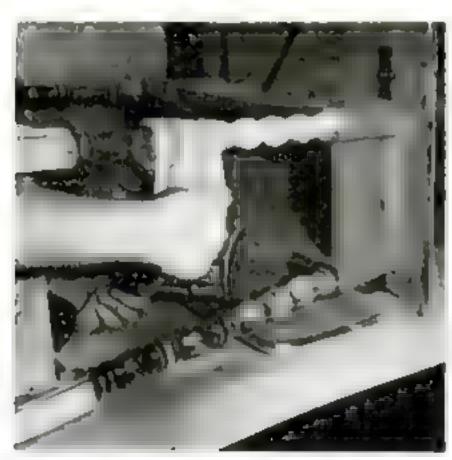




How You Can Use Tube Caps as Replacement Knobs

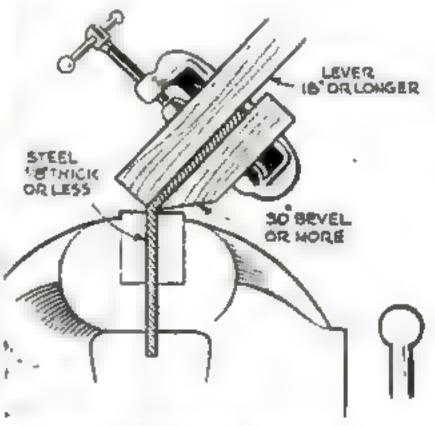
PLASTIC toothpaste caps can replace some push-on radio knobs. To adapt them, use the shank of a twist drill (or any smooth metal rod) slightly larger than the original knob hole. Coat the shank with petroleum jelly, and clamp it

centered in the tube cap. Fill in around with a hardening material, such as plastic patching putty. When it has set, remove the drill or rod. A dab of colored lacquer can be added to serve as a pointer.—Walter Billingsly, Yuma, Ariz.



Smoothing Turned Spindles

STEEL wool is better than sandpaper for smoothing or removing old finish from turned furniture legs—but it's slow. To speed up the job, put a pad of steel wool, folded the long way, inside a strip of upholstery webbing or burlap. Then, using both hands, go to work with shoeshine strokes. You'll hit both high and low spots. Deep coves and other missed parts can be touched up later with a wad of steel wool.—J. Brown, White Plains, N. Y.



Bending Metal in a Vise

Bending flat steel in a vise can be made easier and more accurate with two pieces of wood and a clamp. With the vise jaws at the bend mark, clamp a short, beveled block to the front side of the steel, and an 18" board to the back. Then pull on the longer piece until the metal is bent to the desired angle. This system is easier and produces a more uniform bend than pounding with a hammer,—John F. Marshall, Newburyport, Mass.

WHY I LIKE MY New



KITCHEN: Clip-on Adjust-a-Bilt accessories, an oak plank (for a counter), and a homemade cupboard quickly turned this Panelok wall into a convenient storage and work area.

STUDY OR HOME OFFICE for adult or child—take your choice. Shelves, racks, desk hang from lockstraps. Desk surface is a slab door resting on brackets plugged into wall strips.



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By Darrell Huff

I'VE been building working walls into my home by using a new system called Panelok. It's almost as much fun as a Meccano set—and for the same reason. Once the walls are built you can quickly turn them to a variety of uses by hooking on the right cabinets, shelves, and drawers.

Here are things the system can do:

 Create all the storage facilities needed for an efficient small kitchen on just 8' of wall,

Turn a similar length of wall into a study or home office with generous storage space. A handsome Philippine-mahogany door (2' wide; about \$7) forms the desk in my version.

 Organize a play or study center in a child's room.

 Put a living-room wall to work holding books, magazines, a hi-fi rig, potted plants, shelves, cupboards.

 Make any room or even a quiet corner into a sewing

Organize a closet to do a better job of storing clothes or

linens.

 Add to both neatness and usefulness of storage facilities in a garage or shop.

Since I was starting from scratch, I simply put up two-by-fours on 2' centers. To put up the Panelok walls I had only to nail an 8' slotted metal strip every 2', slipping a grooved panel into each one. The panels are 8' long and just under 2' wide.

The lockstrips that hold the panels are slotted to take brackets and hangers. These brackets offer strong support for the rather remarkable number of accessories made for

Hook-Up Walls



Basic elements of the Panelok wall system

STARTING NEW WALL at the doorway, I nailed up a single-wing lockstrip, making it exactly plumb, above. Wall at left was already complete.

NAILHOLES IN LOCKSTRIPS are at 18" intervals. Special nails come with strips. Visible here are the 34" slots that make wall work.

NEXT, I slipped a panel over the corner lockstrip, fitted a length of double-wing strip into the panel, and nailed strip to second stud.

TWO BRACKETS of this type were slipped into the wall slots at the same height to support special cupboards I made for kitchen and study.



An easy way to make a sliding-door cabinet



1 BUILT A FOUR-SIDED BOX as above, with additional end strips to cover the ends of the sliding-door track. The box can be made to fit across any number of wall brackets. To suit the doors, the height (from the top of one shelf to the top of another) must be 1:1" or 20". The sliding doors, shown below, come in yellow, white, gray, or pale blue, the aluminum track fascia are made in both gold or silver to match the drawer units of the system.



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the system. There are book shelves, close; shelves, and spice shelves; magazine racks, pants hangers, and towel bars; Pegboard brackets and sets of colored plastic drawers.

There are several types of shelf brackets in various sizes. To make a writing deak I plugged in a pair of large ones and placed a slab door over them.

Shelves are even easier to create, and, using the metal tracks and plastic doors that are available with this system, a cupboard is not much more difficult. Hang a pair of shelves one above the other, tack on tracks, slip in doors-and there's a cupboard of almost any desired length or height.

The metal lockstrips and panels that go between them cost about 45 cents a square foot combined. That means you can put up a basic 8' wall for less than \$30. Shelf brackets range from 59 to 85 cents in 6" to 12" lengths. Drawer units run from \$7 for one drawer up to \$43 for three. Magazine racks, plant holders, and other fixtures cost \$2 to \$4.

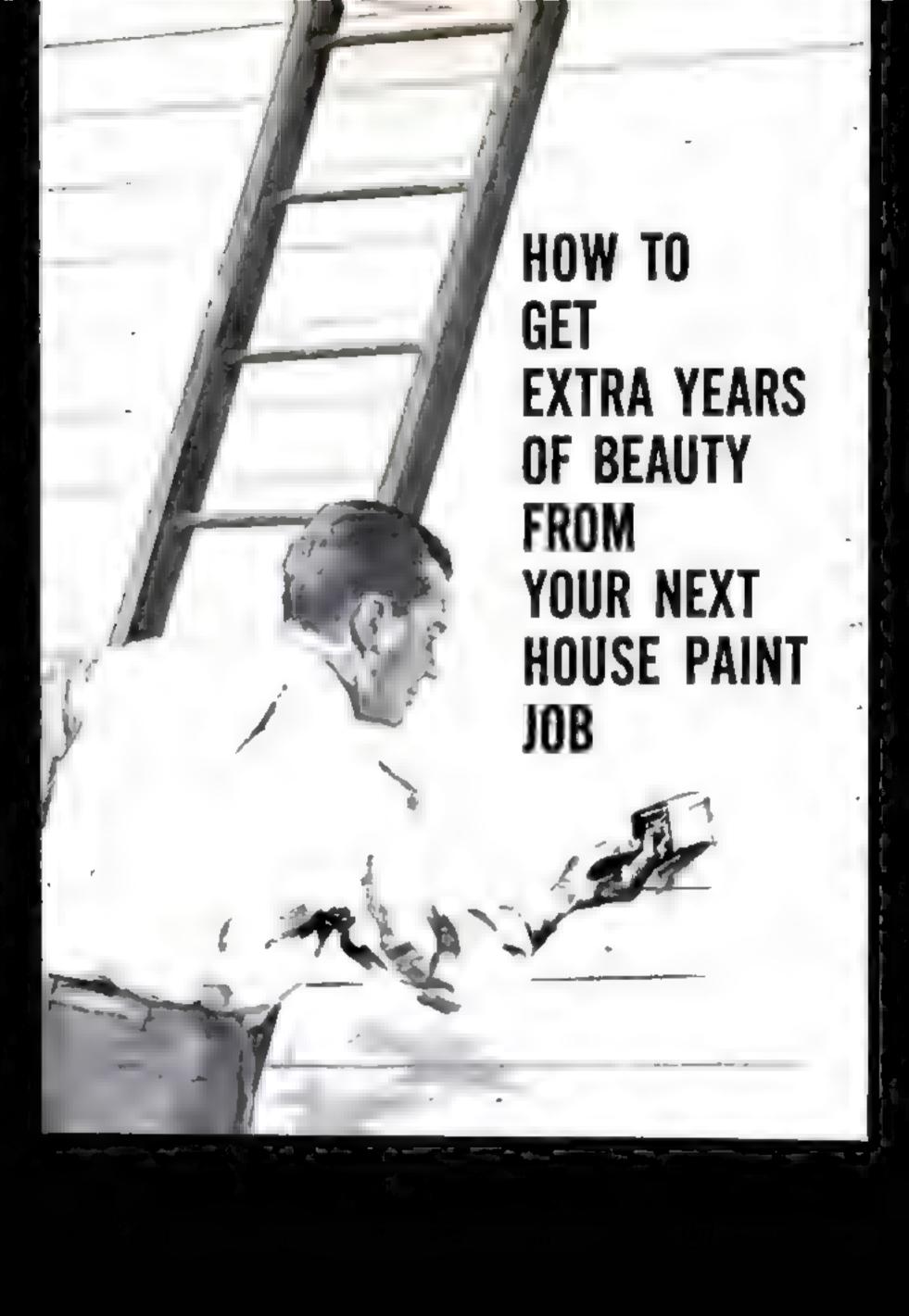
Adding a finish. The panels used in the Panelok system come in plain hardboard, to be painted, or in a variety of wood-grain finishes. Any may be had with a series of grooves to give an effect of wood paneling. For the walls you see in the photographs I used nongrooved panels in a finish called Misty Walnut and wiped on one coat of clear stain wax, using a rag. Where I used these panels in a bathroom I gave them a brush coat of Deft clear finish.

Since I needed the storage feature on only one wall in the bathroom, I saved money by using regular 4'-by-8' hardboard panels on the other walls. These may be had in finishes to match Panelok.

A new gadget also makes it possible to use most of the drawer units, shelves, and racks on any wall of heavy-duty perforated hardboard. It's an adaptor that slips into a pair of adjoining holes.

The Panelok wall system and Adjust-A-Bilt accessories are made by Masonite Corp., 111 W. Washing-

ton St., Chicago.



LUCITE®... GREATEST HOUSE PAINT DISCOVERY IN THIRTY YEARS

Outstanding Durability, Easy Application, Superior Blister Resistance Can Save You Hundreds of Dollars

With Du Pont's new "Lucite" Acrylic House Paint you may only have to paint your house once a decade. This amazing new paint discovery is made with "Lucite" acrylic resin, similar to the acrylic resin used so successfully in the longer lasting "Lucite" Auto Finishes.

Du Pont scientists have tested it for years in all kinds of weather, in all parts of the country. These tests proved that it will last 50% longer than conventional house paints when applied to properly prepared wood or masonry surfaces. "Lucite" House Paint also provides excellent resistance to moisture blistering, a real problem for many homeowners.

How to Make Your House Paint Job Last 50% Longer

To gain the maximum benefits of extra durability and blister resistance from the use of this amazing new house paint, you should start your painting from a bare wood surface. This may be either new wood or old wood from which the previous coats of paint have been completely removed. However, such bare wood surfaces should first be primed with the specially formulated Du Pont Blister-Resistant Primer. Following this, simply apply two coats of "Lucite" Acrylic House Paint.

Performance over previously painted surfaces will be determined largely by



SERVES AS PROTECTIVE LUCITE" SHIELD FOR HOUSE.

Because of the hard, smooth "Lucite" surface, heavy rains wash off surface dirt, keep your house beautifully clean and fresh. Destructive weather can't penetrate hard, low sheen finish

the condition of the old paint. It is not possible to assure freedom from blistering, cracking, flaking or peeling unless the old finish is completely removed. If the old finish is definitely firmly adhering, with little or no chalking, good durable lity can be expected, provided you use one coat of Du Pont Blister-Resist-

ant Primer, followed by two coats of 'Lucite"

If the old paint is in poor condition hadly powdered by stered or peeling it should be completely removed by burning or power sanding. If you cannot do this, follow the advice on pages 184 and 185 of this booklet.





LUCITE DRIES IN 30 MINUTES: YOU CAN APPLY TWO COATS IN ONE DAY

Another Big Advantage of New Du Pont 'Lucite' Acrylic House Paint:

FAST DRYING

First top coat dries in 30 minutes, saves you moving your ladders, staging or scaffolds. By the time you finish painting a section, it will be dry for a second coat

Paint dries before dust or bugs can damage the surface

APPLY TWO COATS IN ONE DAY

. Save time

Save money

Finish the job faster for savings now, as well as for years to come

CLEANING UP AFTERWARDS IS A CINCH

Immediately after using, cleaning up is a cinch with the new Du Pont "Lucite" Acrylic House Paint. Fresh paint spots wipe off with a damp cloth. To clean your brush, roller and hands, just use

warm water under the tap. No irritating smelly solvents. No mess or bother.

Unlike most exterior house paints, "Lucite" can be thinned with plain water when necessary.



LUCITE DOES WONDERS FOR STUCCO, MASONRY

Outputs the best Heart Pant test of stars
concit the best and three Or new or proacted besons
apply directly two coals that the profession of the coals that the
concern of a surfaces previously points with a point that is
defined to a transport of two coals to be present that is
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DU PONT LUCITE® GIVES WHITEST WHITE, 16 SMART FADE-PROOF COLORS

Because of the crystal-clear acrylic resin in "Lucite" House Paint, colors are wonderfully true and beautiful. The tough resins help protect colors from fading in the sun and also from weathering. The white is especially brilliant, and reflects sun heat, keeping your house cooler in the summer. Not only does it last longer than other whites, it also does not "yellow." In addition to longer lasting white, "Lucite" comes in 16 lovely colors to give your home new warmth and distinctiveness. These colors may be intermixed to provide still greater variety.

"LUCITE" PAINT WON'T CHALK-STAIN ADJACENT DARK BRICK AND MASONRY

The chalk-resistant properties of the new "Lucite" Acrylic House Paint keep it from running down and discoloring dark walls or masonry the way many house paints do. Its long-lasting velvety sheen minimizes dirt collection and helps hide surface imperfections like scratches or holes.

The tough acrylic resins in the finish help resist driving rains, snow, ice, baking sun, sea air, salt water spray, alkali, mildew and smog. Houses have that freshly painted look years longer with the new Du Pont "Lucite" Acrylic House Paint.

YOU CAN NOW PAINT RIGHT AFTER SHOWERS OR DEW

With the new Du Pont "Lucite" Acrylic House Paint, you don't have to wait for the house to dry after heavy morning dew or sudden showers. It applies easily over damp surfaces. And sets up quickly to resist water spotting. However, the alkyd-base primer should always be applied over a dry surface.



PAINT BLISTERING PROBLEM NOW

Blistering, long the homeowners' biggest headache, now gives way to the chemical research that created Du Pont LUCITE* Acrylic House Paint. Used over new Du Pont Blister-Resistant Primer, on new wood or on old surfaces from which the paint has been removed, it resists unsightly blister damage.

Blistering is usually caused by moisture vapor from inside the house—from the shower bath, the laundry and from cooking, or from rain entering through cracks and other openings in the siding. This vapor sometimes works its way through the wood. Ordinary paint on the outside of a house forms a film that moisture can't get through. This moisture often pushes the paint away from the wood and causes the paint to blister.

This new Du Pont paint system prevents blistering two ways:

 The new primer penetrates deeply and adheres to the surface exceptionally well. "Lucite" is porous enough to allow the moisture vapor inside the wood to escape without causing blisters.

If the present paint on your house is blistering, the old paint film must be completely removed and the bare wood thoroughly sanded. If this is not done, blistering is apt to recur on those sections where the old paint has not been removed.

Eliminate, as far as possible, the sources of excessive humidity or moisture within the structure. Caulk cracks and other openings in the siding. Vent to the outside the moisture vapors from laundry dryers, shower baths and kitchens. Clean out clogged gutters.

Apply Blister-Resistant Primer and one or two coats of "Lucite" Acrylic House Paint. Du Pont tests indicate that this finishing system solves the blistering problem in about 90% of the cases.

Ask your Ou Pont Paint Dealer for free folder of 16 beautiful "Lucite" colors and painting instructions.

SOLVED BY DU PONT LUCITE® HOUSE PAINT OVER NEW PRIMER



Laboratory Bi-ster-Test shows how regular house paint, on upper panels, blisters under abnormal moisture conditions. Panel, fower right, painted with "Lucite" Acrysic House Paint over Du Pont B ster-Resistant Primer, shows no sign of blistering.

LUCITE® PAINT SYSTEM 100% SUPERIOR OVER YELLOW PINE

Paint manufacturers have long recognized that one secret of durability is a good primer. Du Pont Laboratories developed Blister-Resistant Primer to give maximum protection over any kind of wood . . including yellow pine.

The new primer contains DULUX* alkyd resins and special solvents to assure deep penetration. It gives excellent adhesion over yellow pine . . . 100% more effective than any conventional paint. It also offers maximum resistance to unsightly moisture blistering, cracking and peeling when used over new or unpainted wood and top-coated with Du Pont "Lucite" Acrylic House Paint.

Read the Answers to These Painting Questions

LUCITER works such wenders on weed and mesonry that it deserves to be used a properly.

If you're planning to apply new paint over old, remember this: the durability of your paint job will depend censiderably on what happens to the old paint underneath. This is true of any paint you apply, if the old paint film breaks away from the wood or masonry, or is so old and powdery that the new paint can't penetrate to a sound foundation, your new paint job probably will not last long.

If you use "Lucite" according to the recommendations in this booklet, you can expect a bonus of many years of extra durability. We realize that eir-burnstances may prevent you from going to this extra effort. If this is the use, we'd like to suggest that you use one of the other fine Du Pont House Paints that your Du Pont Paint Dealer will recommend. For years, these fine products have earned the high praise of painters and homeowners, because they consistently afford leeting durability and good appearance.

Read carefully the questions and unewers given here. They'll help clarify whether you should use "Lucite" or one of the many other performance—
proved Du Pont House Paints.

IF YOURS IS A WOOD HOUSE

QUESTION Do I have to remove the old paint before applying. Lucite ?

ANSWER It's certainly best to do so to assure complete free-lorn from a stering cracking faxing and peeling. However, firmly adhering oid, and a good condition may be repainted with one full coal of Du Pont Blister Resistant Primer, for lowed by two top coats of "Lucite".

Q I don't want to remove tally weathered old paint. What do you recommend?

A Remember that a paint job is only as good as its foundation. This is true of any paint you use. When the old paint is in very poor condition it is best to remove it entirely. However, if you just can't devote that much time and effort, your local Du Pont Paint, Dealer will be happy to recommend the right paint for the job. For example, one of those described in the tiox at the bottom of the next column could fit your needs.

Q Can I skip the printer coal before I apply "Lucite" to a bare-wood surface?

A No You should never use 'Lecite" unless the surface has been properly prepared Applied over one crat of Du Pont Brister-Resistant Primer, durable "Lucite" Inish is extremely resistant to mosture-bi-stering cracking and peeing, should give 50% longer life than ord nary house paints

Q Do I have to use the special primer before applying "Lucite" the next I may house?

A Ne If you've applied "Lucilo proporly the first time, you shouldn't have to repaint again for years! But when you do

184 POPULAR SCIENCE MAY 1960

it's not necessary to use primer again. Just make normal surface preparations and apply one or two coats of LUCITE® House Paint right over the old coat. You'll have a beautiful new finish that will give you maximum durability and lasting good appearance

Q. What do you recommend for a onecoat paint job over a previously painted surface?

A. Here's one instance in which "Lucite" can't help you. However, any of the outstanding Du Pont House Paints described in the box (below) may be suitable. Your Du Pont Paint Dealer will be glad to recommend the paint that fits your needs exactly.

A BURABLE OU PONT HOUSE PAINT FOR EVERY EXTERIOR SURFACE

In addition to "Eucite". Du Pont research has developed a variety of other durable house paints especially designed to protect every exterior surface of every house. Thus, your Du Pont Paint Dealer can outfit you with exactly the right paint for the Job.

ND. 40 OUTSIDE WHITE HOUSE PAINT: A self-c earling paint for all-wood houses. This durable finish starts white and alays white.

NO. 41 OBTRIDE WHITE HOUSE PAINT: The ficest house paint available for those who prefer a lead-base paint. High hiding.

NO. 42 CHALX-RESISTANT HOUSE PAINT: A durable, ready-mixed exterior finish ideally suited for houses that are part wood, part masonry or stucco. Won't stain adjacent surfaces, may be tinted with Du Pont Gustom Tinting Colors for hundreds of attractive shades.

"BULUX" STUCCO, SHAKE AND SHINGLE PAINT: A durable protective and decorative finish that seems out moisture penetration; preserves distinctive texture of original purfaces

coton-fast outside Mouse PAINT: 18 exciting Du Pont colors to give your home new warmth, distinct veness and Individuality Excellent brushing qualities for swift, easy apprication.

OR MASONRY HOUSE

QUESTION. What is the recommended system for new masonry?

ANSWER. Allow new masonry surfaces to age thirty days. No special primer is required—simply apply two coats of "Lucite" House Paint directly to the masonry surface. Wetting the surface before applying the first coat is suggested, particularly during hot weather.

Q. What preparation is necessary before repainting over previous coats of paint?

A. First, completely remove all dust, dirt, efflorescence and loosely adhering and powdered old paint by sanding or wire brushing. Then, if old finish shows good adhesion and only light chalking, simply apply two coats of "Lucite" House Paint. If old finish is in average to poor condition, follow the recommendations given below.

Q. When is primer necessary for masonry?

A. You should use primer on any masonry surface in average to poor condition, if old finish shows medium chalking and only slight peeling or erosion, apply a primer coat of Du Pont 919 Masonry Surface Conditioner, followed by one or two coats of "Lucite" House Paint. Old water-soluble coatings such as white-wash and calcimine, which show excessive chalking, peeling and flaking, should be completely removed by sandblasting or power wire brushing.

This also applies to cement coatings in similar condition. Following removal of the old finish, apply one coat of 919 Masonry Surface Conditioner and one or two coats of "Lucite".



while makes the difference

the original property and about.

When you figure the total cost of painting and repainting your house over the years. It's easy to see how you can save hundreds of do lars by using this remarkable new paint that lasts 50° longer. And you'll pay just a few do lars more for all the LuCITE! House Paint needed for most houses. Most dealers self it for about a dollar more perigation than conventional fine-quality house paint.

TEAR OUT THESE PAGES . . for Handy Reference

DVERTISE.

Just piece y ur left hand on the facing magazine page then firmly grasp these special pages with your right hand and paid them pently away. Keep them for handy reletance wherever you decide to paint your house.



Buy the paint that's worth the work . the beauty lasts

BETTER THING I FOR BETTER . . P.T.

THE THE CHEEK 170

Transistor Dwell Meter

Accurate setting of dwell angle is vital for a smooth engine. This meter puts it on the nose

By E. F. Lindsley

ATHIN dime was once the accepted tool for adjusting breaker points. Now, of course, even a shade-tree mechanic has a feeler gauge. A real technician may struggle with a dial indicator for nth degree tune-ups. But, at best, setting the point gap is a backward approach. The real object of the adjustment is to control the time of current build-up in the ignition-coil primary. The actual measurement of this is the dwell angle—the number of degrees through which the cam rotates while the points are closed

Incorrect dwell angle can cause misfiring at low speeds if it's too large, or misfiring at high speed if it's too little. Worse, it changes the timing if it's off in either direction. An error of, say, three degrees in dwell angle will throw the timing off three degrees.

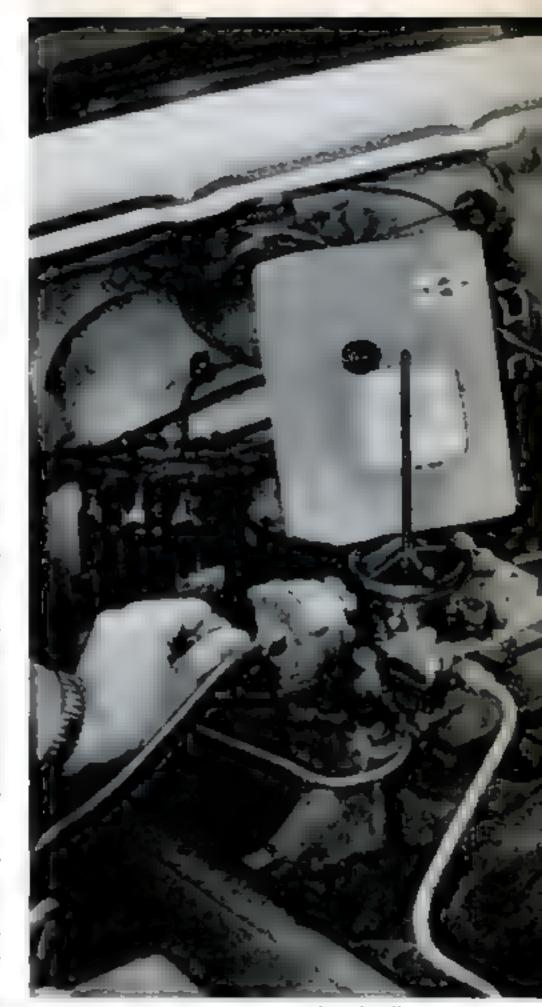
Gapping the points accurately can indirectly give you the proper dwell provided a couple of mighty big ifs don't interfere:

• If the contact surfaces are smooth.

 If no mechanical variations sneak in at different engine speeds

Dwell meters measure dwell angle directly—eliminating all the vagaries of the indirect, gap-measuring method. Since the measurement is made while the engine is running, it can also show up troubles like wobbling distributor shafts or sloppy breaker plates.

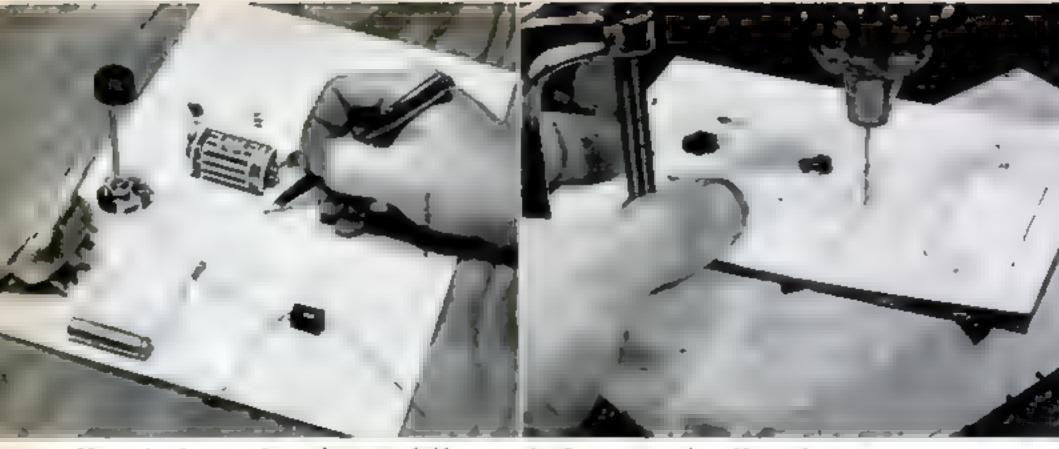
Many excellent dwell meters are on the market at prices ranging from \$15 to way higher. For less money, and more fun,



PRECISE DWELL ADJUSTMENT with a dwell meter it easy for anyone. It is especially handy on cars that have external point adjustment. On these, you don't need to open the distributor.

you can build one that will be as accurate as the care you use in building it. For this one, I spent about \$8 on the electronic parts, and scrounged the incidental hardware, plywood, etc. from around the shop.

Laying out the parts. The physical layout is not critical. An experienced radio builder can easily squeeze the parts into a much smaller package. I took plenty of room and made up a separate circuit board for the small parts so you



How to lay out and mount the parts for your dwell meter

simple transistor circuit can be arranged to suit any reasonable size and shape case has out parts on cardboard sketch in connections and mark holes to be drilled for monoting parts CARDBOARD LAYOUT serves as a drilling template. Use a piece of stiff their insidating board for your subpanel. Champ the cardboard template to it and drill through at each marked hole.



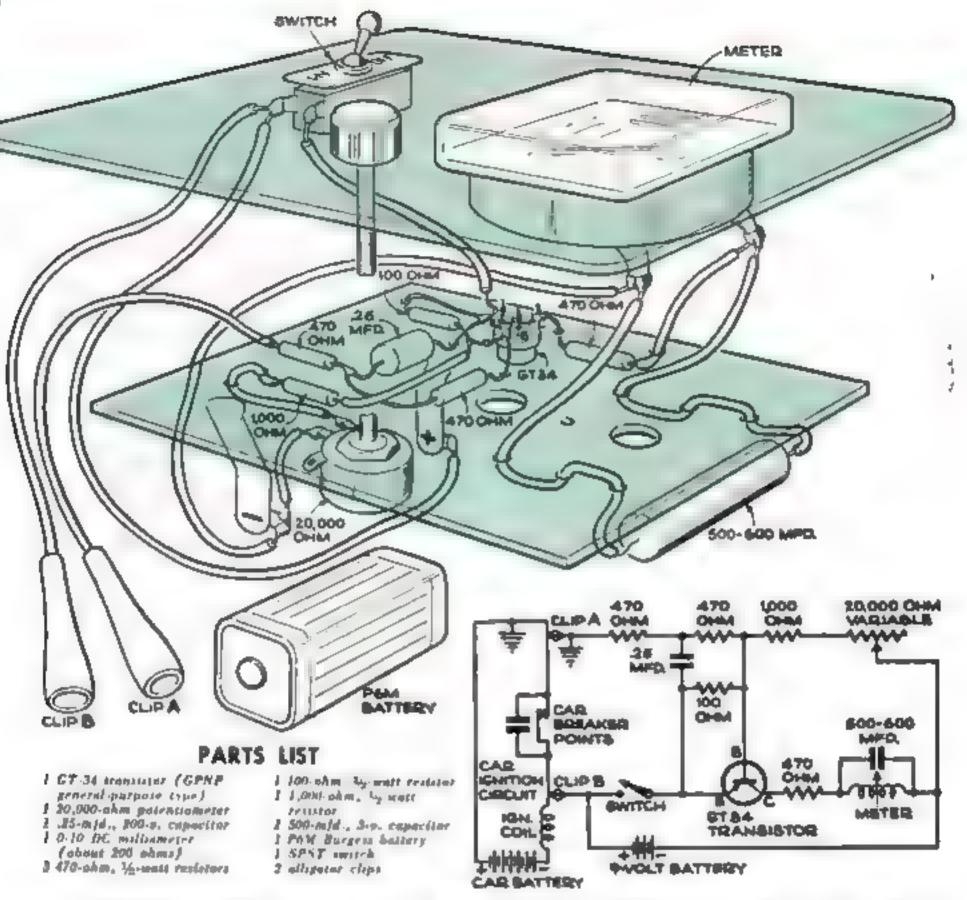
TERMINAL WIRES of the various components are poked through the holes and connections soldered on the other side. Use longer flexible wires for connections to meter and switch.

SUBPANEL IS MOUNTED by screws into the meter bracket. Switch and meter are mounted on front cover panel. The shaft of the adjusting potentioneter extends through a hoje in the cover.

don't have to be a soldering-iron virtuoso to duplicate the one I made.

I dumped the parts out on a piece of shirt cardboard and pushed them around until I found an arrangement that seemed reasonable. Everywhere it looked as if a wire could be poked through a hole to secure the component and provide a connection on the other side, I made a pencil dot. With the layout completed, I clamped the cardboard to a piece of stiff

fiber insulating board and drilled through at each pencil dot. The components were simply and securely mounted by poking their wire leads through these holes and bending them over tight against the other side. Appropriate wires were twisted together and soldered to complete the circuit board. Thus, all the components were on one side and all the solder joints on the other. There was nothing that could shake loose.



The battery clips were made from two strips of brass from an old light socket. These were riveted to the board with eyelets. Battery terminals were snipped from an old portable radio and soldered to the strips. Be sure you get the positive and negative terminals right. One shot in reverse can ruin a transistor for keeps.

The instrument-box cover is made from Formica, and for the box itself, I used plywood.

Dry run. After soldering up and rechecking the wiring, give your meter a dry run to see that all is well. Clip one test lead to the primary terminal on either the distributor or coil and the other to ground. Turn the instrument on and ease the adjusting knob around until the needle barely tickles the pin at the right end of the scale. Start the engine.

If your ignition system is in fairly normal health, the needle should drop back to the mid-scale region. If nothing happens, interchange the test-lead clips. If still nothing happens, you've gone astray in your wiring.

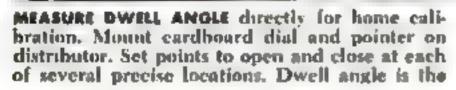
A good feature of this instrument is its ability to ignore minor electrical differences in the ignition system. I tested it on the bench and on various cars. Six or 12 volts makes no difference. Neither do normal variations in point resistance. Some cars have negative grounds, some positive. Merely interchanging the test-lead connections takes care of this.

Final calibration determines the ultimate usefulness of your dwell meter. Happily this is not as tough as it may seem at first.

A range of 20 degrees to 40 degrees will handle any practical job on any en-

How to calibrate your dwell meter before making a new







difference in degrees indicated at "points close" and "points open." Bun engine with meter connected, and then mark the needle position accordingly on the temporary meter scale.

gine. So there is no need to calibrate to the extreme ends of the scale. Fortunately this range you will use—right out of the middle of the scale—is also the range of greatest accuracy for a meter and circuit of this type. The scale divisions will tend to squeeze together at either end but, since you're not going to use these extremes, there is no need to fret about it.

Knowing the angles. Think a minute and you'll come to the conclusion that a six-lobe cam on a six-cylinder engine can approach a maximum dwell angle of 60 degrees (360 degrees divided by six equals 60 degrees). An eight-lobe cam used on an eight-cylinder engine divides out to 45 degrees. Hence, midpoint on the scale is about 30 degrees for a six, or 22.5 degrees for an eight. In practice, with the usual dwell angles, this puts the working range in a general midscale area.

The easiest way to calibrate is to persuade an amiable garageman to let you check it out with his commercial meter. Prepare your meter shead of time by removing the cover and taping a piece of paper over the existing meter scale. Make a set line on the paper just short of full-scale needle deflection. Before calibration, and each time before using the meter, turn the adjusting knob until the needle

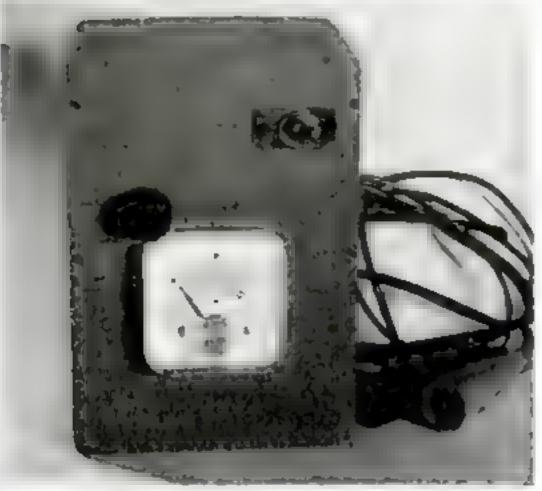
lines up with this mark when the meter is turned on.

To make the meter useful for all engines, you'll need to lay out only two scales—one for six cylinders and one for eights. Fours are taken care of by using the eight-cylinder scale and multiplying by two.

Bench-run both a six- and eight-cylinder distributor. Adjust each in turn to
20, 25, 30, 35, and 40 degrees of dwell
angles. Each time you get the adjustment pegged using the commercial meter,
hook up your home-grown job and mark
the needle position with a pencil. Later,
you can ink up a more handsome scale
and carefully paste it in exactly the same
position.

A distributor-shaft pointer. If you're bashful about imposing on your local garageman, another avenue is open, It's a little more tedious, but the results can be just as accurate. Make a cardboard ring to fit snugly around the distributor housing. Use a protractor to mark off the degrees (0 to 60 for a six; 0 to 45 for an eight). Bend a pointer of stiff wire and snap it on the distributor shaft. Set the points to give various dwell angles as above. Each time, replace the rotor and distributor cap and run the engine. With the meter connected, mark the corre-

permanent scale for it



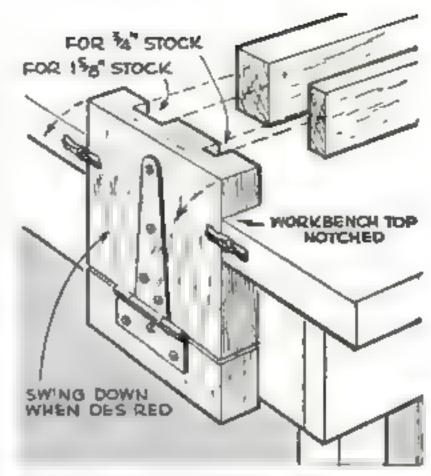
PERMANENT SCALE is inked by transferring the markings from the temporary scale. Spaces between check points can be marked off in equal divisions. Paste scale accurately in place.

sponding needle position with a pencil. The dwell angle is the difference in the indication on the cardboard scale between the points at which the breaker points close and open. You can use the meter to establish the exact point of closing and opening. It will show the make and break if the ignition is on.

Once you have the main divisions marked, it's easy to space off divisions in between. Theoretically, these are not perfectly linear, but you'll be so close your car will never know it.

car's shop manual for recommended dwell angle. They vary slightly from one make to another. Ordinarily, you'll find that four-cylinder engines call for about 40 degrees, sixes about 38, and eights about 28. If the needle flickers when the engine is gunned, or if the needle moves and doesn't settle back to the same point, suspect a worn distributor-shaft bushing, a sloppy breaker pivot, or a breaker plate that wallows in its supports. Until such defects are repaired, the car cannot be properly tuned.

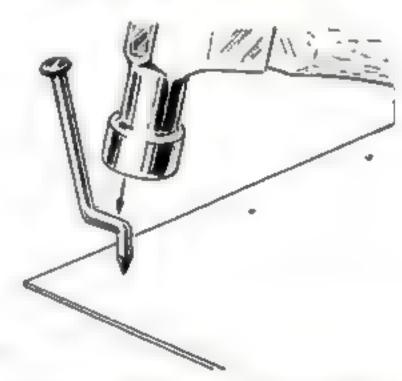
A final word—remember that changing the point setting (dwell angle) also changes ignition timing. Always reset timing after adjusting the points.



Fold-Down Planing Stop

Theo of nailing stop strips to the top of your workbench, only to wrench them up the next time you need the full flat surface? Here's a stop that folds out of the way when not in use. Run vertical grooves across one face of a two-by-six to take the most common stock thicknesses. Recess this into the bench top, hinging it to a two-by-four block secured to the end apron. If your bench top projects more than the thickness of the stop, rabbet a seat for the turn-button on each side of the notch.

—Victor Lester, Albany, N. Y.



Emergency Punch from Spike

A PRICK punch can be improvised quickly by making two bends in a spike about an inch apart. The resulting shoulder receives the hammer blow while your fingers safely grip the canted shank.—G. E. Henry, Milianukee.



she grips Richardskeeter's handle for support. Speed of 14-pound scooter can be set at 3 to 12 m.p.h. She stops by fixing right front drive wheel off ground

POWER UNIT rides ahead of the front wheels in a bracket that turns with them. On left side is the fan and the chain connecting engine shaft to countershaft.

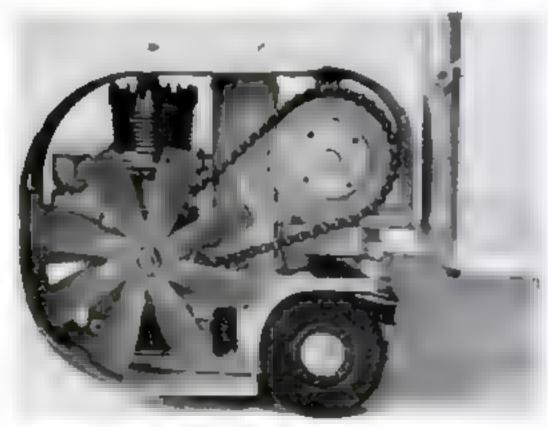
A Model-Plane Engine Runs My Scooter

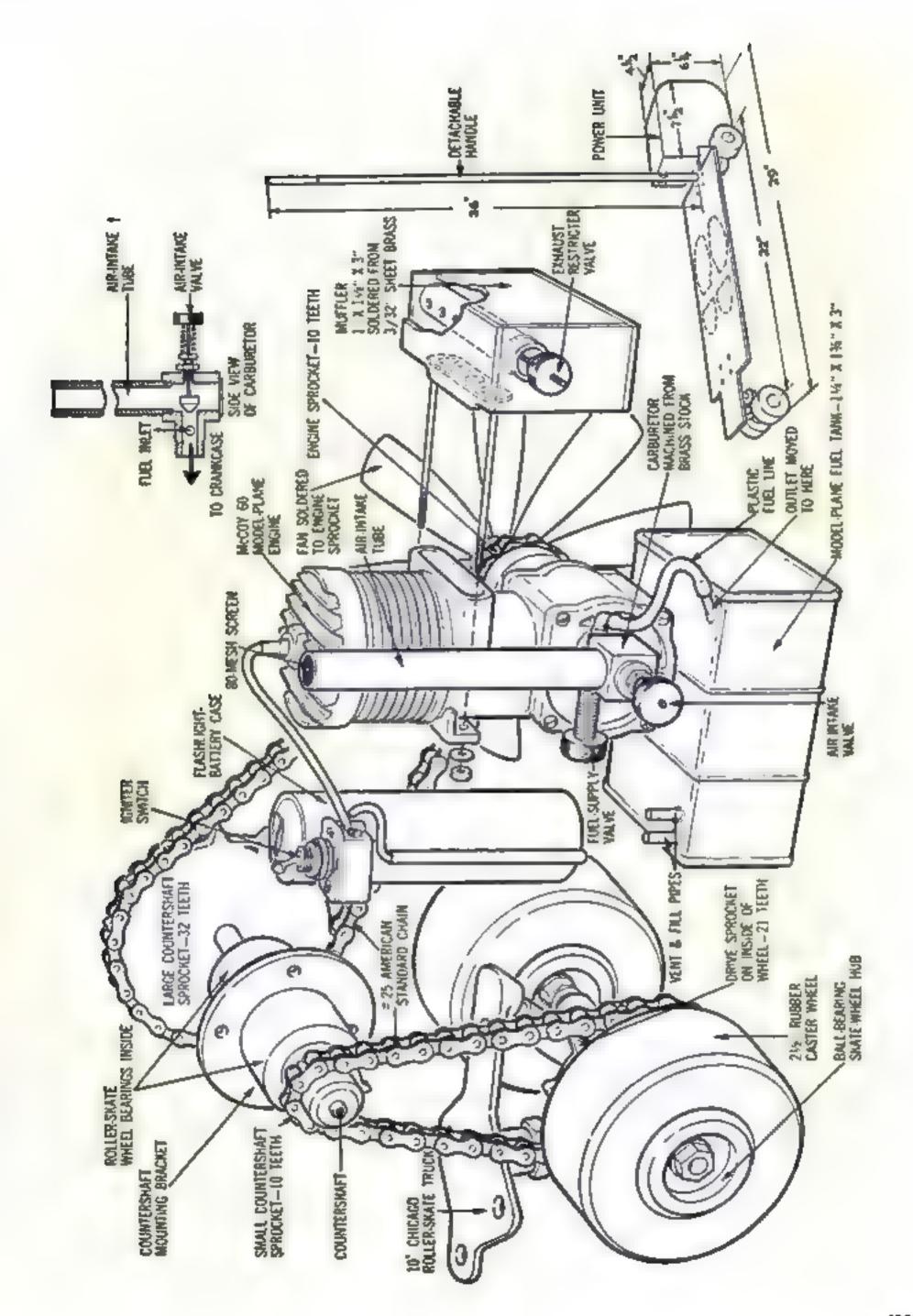
By Louis R. Richards

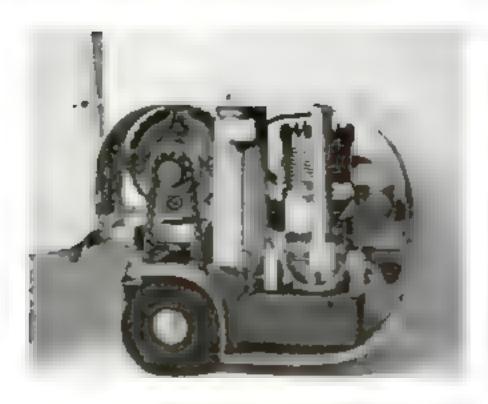
RIDING the Richardskeeter is fun. Just lean, and the little scooter goes in that direction while you hang on to the handle. It speeds up to 12 m.p.h. It's even been to college: I invented it doing product-design work at the Illinois Institute of Technology.

This "powered footprint" vehicle is similar to the roller-skate scooters kids nail together. But steering one was always tough, if not impossible, so that was the first thing I tackled. Figure roller skates—they have wheels that pivot—proved to be the simplest answer.

I riveted two figure roller-skate trucks to adaptor plates and bolted these in turn to an aluminum platform, with the trucks facing one another. The fiber skate wheels would have worked all right, but to get a smoother ride, I replaced the







RIGHT SIDE OF POWER PLANT has final drive chain from countershaft to wheel sprocket, a battery case for ignition (large tube), and carburetor. Thin tube is carburetor air intake.



WITH HOUSING REMOVED, mounting bracket is visible—it's welded to the skute truck. Bracket, housing, platform, and handle are aluminum.



inventor tanks up on model-engine fuel that carries him a mile for eight cents. He'd like a similar gasoline engine for more economy.

fiber wheels with rubber ones from casters.

The skate wheels had ball-bearing hubs (which I wanted), whereas the caster wheels had sleeve bearings (which I didn't want). The fiber wheels came off their hubs easily. I knocked out the sleeve bearings and enlarged the holes in the rubber wheels to fit the skate hubs.

Front-wheel drive, with the power plant ahead of the front wheels, kept the center of gravity low and the drive train short. I made the power unit turn with the front wheels by welding the powerplant bracket to the front skate truck.

The heart of Richardskeeter is a \$40 McCoy 60 model-plane engine. I chose it because its ball-bearing "mains" can stand up under the thrust of a chain drive. Normal engine r.p.m. is 17,000. This is too fast for a scooter. Gearing it down enough would have been complicated and expensive. Slowing the engine seemed like the best bet, but there was no throttle.

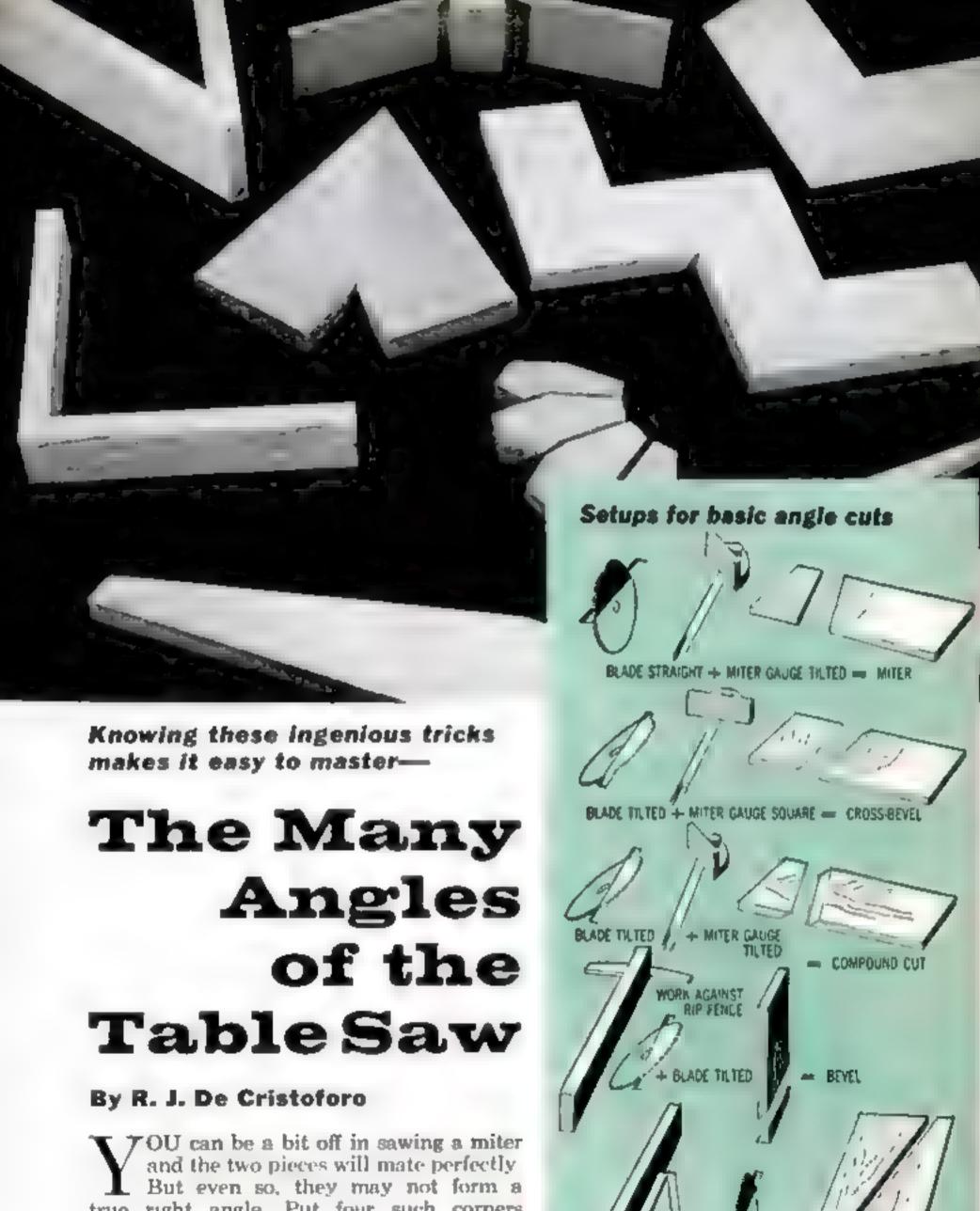
The carburetor I turned out on a lathe was completely new except for the McCoy 60 needle valve and split nut. This became the air-intake control valve. Another needle valve metered the fuel. To improve speed control further, I put an adjustable exhaust restricter in a homemade muffler. Adjusting the three valves together throttles back the engine to a minimum of 6,000 r.p.m., a maximum of 8,000—about ¼ and ½ hp, respectively.

Fuel is carried in a model-plane tank under the carburetor. Short lengths of plastic hose on the fill and vent pipes keep fuel from sloshing out. I moved the outlet pipe so the plastic fuel line could run directly to the carburetor.

Hidden behind a housing, the engine needed extra cooling. A 4½"-diameter fan made of ½" sheet metal took care of that. I silver-soldered the fan's center directly to the drive sprocket.

Ignition was the easiest part—a flashlight battery hooked up to the glow plug through a switch. To start, I simply flip on the switch for a moment and push off. The plug heats up and fires the mixture as the drive wheel turns the engine over.

To transmit power from engine drive shaft to right front wheel, I used a countershaft with chains and sprockets. Overall gear ratio: 6:1. There is no clutch. You stop by lifting the drive wheel off the ground, go by setting it down.



true right angle. Put four such corners together in a cabinet or picture frame and you'll see why there'll always be a market for patching putty.

Sawing accurate angles needn't be fussy if you know the correct setups for each

WEDGE AGAINST RIP FENCE + BLADE STRAIGHT - TAPER



Every angle-cutting problem has an answer. Here are ways

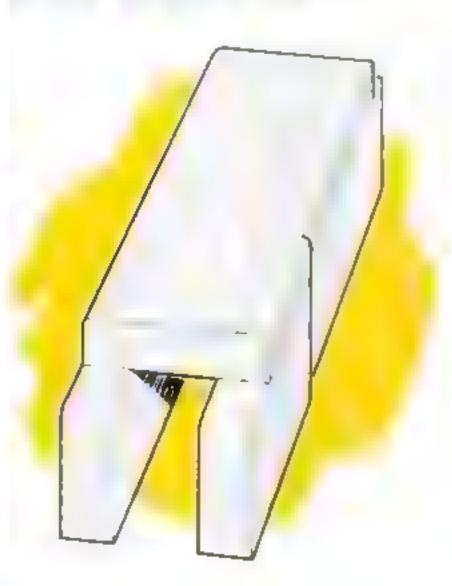
set accurate angles on your miter gauge by marking the saw table ahead of time. Use a ball-point pen to lay out the most commonly used angles. Adjusting the miter gauge to these lines is then faster and more precise than relying solely on the miter-gauge scale.

"IMPOSSIBLE" ANGLES can be made this way. Where pieces are too large to use a miter gauge, tack a narrow wood strip to the underside parallel to the cutting line. The strip rides in the miter-gauge groove and holds the work steady no matter how long the cut is.

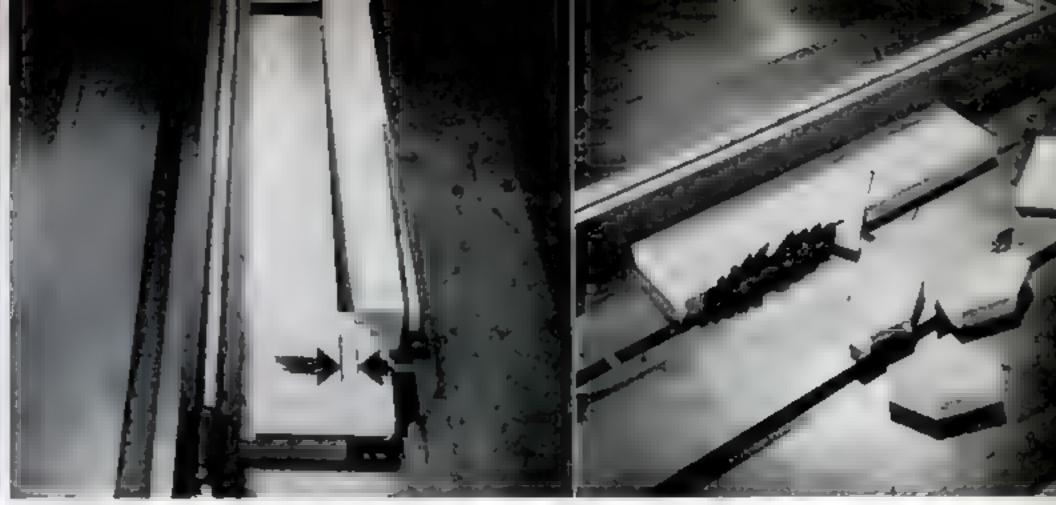
Cross-beveling narrow strips calls for this upright jig



CROSS-BEVELS at less than 45 degrees must be made with the work held vertically against the fence because the blade can't be adjusted sharply enough to use the table. This U-shaped jig slides along the fence, holding the work firmly against a notched shoulder to insure a true cut. Make the jig a snug fit and keep the fence waved so the jig will slide easily along it.



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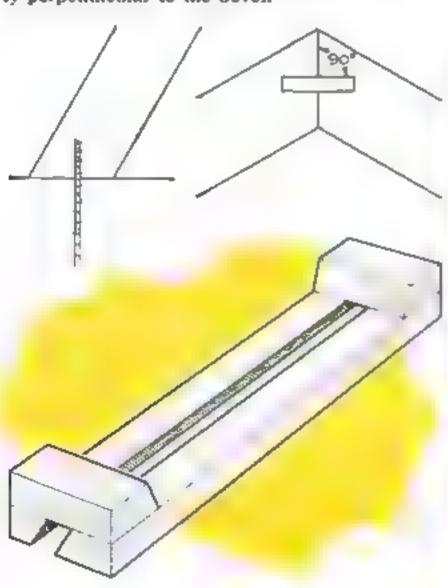
to improve the ease and accuracy of four difficult jobs

LONG TAPERS ARE EASY with this notched jig. Work is held in first notch for cutting one side, then is reversed and, being thinner, is placed in the second notch for cutting the opposite side. Amount of taper is controlled by width of notch (arrows) and the length of the jig.

"POCKET" GUIDE accurately positions oddshaped pieces too small to hold by hand. Make a cutout in a board to match the shape of the work, leaving the part to be sawed off protruding. Then just drop the pieces into the pocket and slide the guide along the fence.

How to make splined joints the easy way

correct angle while you saw it. This slotted jig, cut to match the bevel angle, automatically holds the work at the proper slant while you slide it over the blade. This makes it easy to cut grooves for splines, which must be absolutely perpendicular to the bevel.

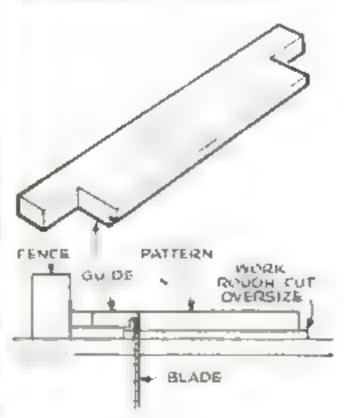




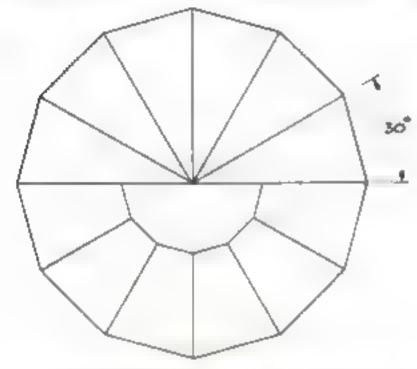
Pattern sawing turns out duplicate shapes fast



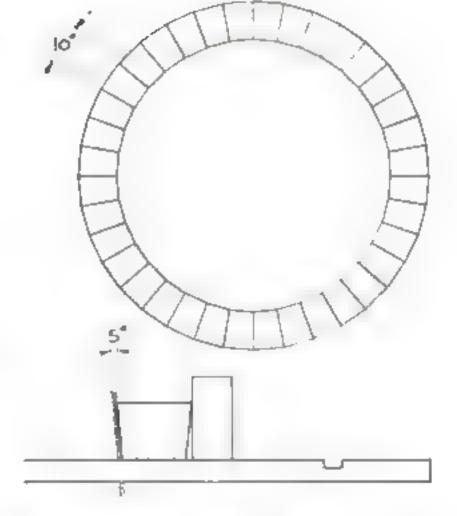
complicated angles can be copsed quickly this way. Cut a pattern and tack it to a slightly oversize workpiece. The pattern rides along the jig clamped to the fence, duplicating each cut in the work.



How to make circles from straight cuts



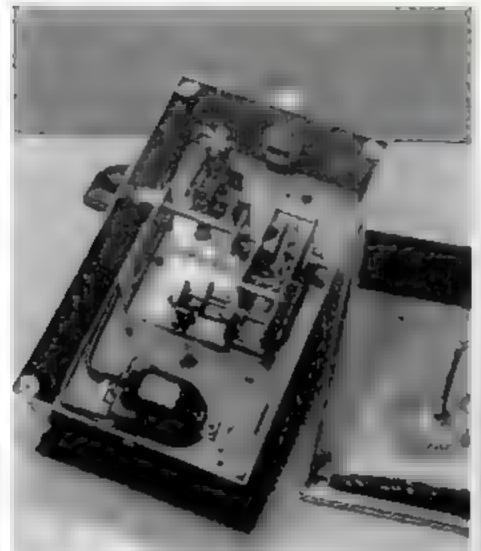
PIE-SHAPED SEGMENTS glued together form lamp columns, trava, or lathe turnings. If you want a center hole for a lamp cord, cut off tips of the wedges. Hollow columns for planter boxes can be made with thin 10-degree segments, as at right. Cut a five-degree bevel on each side.



type and the special jigs that make them come easily. You cannot, for instance, cut a 30-degree cross-bevel with the work flat on the saw table—the blade won't tilt that far. But you can do it if you hold the work up against the fence as if making a rip cut. This is impossible to do by hand, but one of the jigs shown here makes it easy.

Cutting long, finicky tapers is another job that drives many people crazy. It needn't. Again, a special jig makes it almost foolproof Other jigs and setups make it possible to solve any anglecutting problem. For accuracy, never rely solely on your saw settings. Make trial cuts on scrap first and you can be sure the real thing will be perfect.

ISB POPULAR SCIENCE MAY 1960







Toaster Timer Makes Delayed-Action Light Switch

THE timer from an old toaster made the delayed-action switch in my garage. Rated at about 1,000 watta (the case with most toasters), it can carry the load of the garage light, an outdoor spotlight, and several outside door lights. The delay action leaves the lights on long enough for me to close the garage door, walk to the house, find my key, open the door, and get inside.

Any toaster with a timer, whether automatic or manually operated, can be used

Nonslip Ladder for a Garage

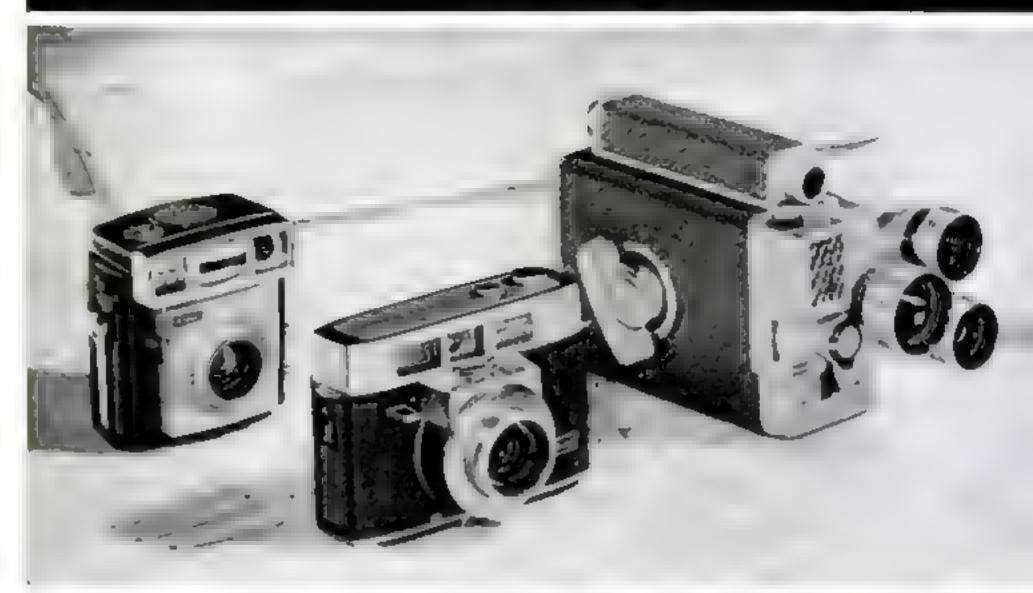
A SHORT, straight ladder will give you easy access to the overhead storage space in a garage. To keep the ladder from slipping, attach angle braces to the top ends with 1½" wood screws. When not in use, the ladder can be hung out of the way from the top of a wall.—Arthur N. Nelson, Kunsus City, Mo.

clearance-hole diameter for a number-size machine screw, here's how to figure it. Thirteen times the screw number plus 60 gives the hole size in thousands of an inch. Example: For a No. 6 screw, 13 times 6 is 78, plus 60, equals 138 (thousandths of an inch). A No. 28 drill (diameter .140") will do the job.—Joseph Whitehill, Easton, Md.

Mine was operated by a lever, I removed it, extended the shaft outside the toaster base, and put on a radio knob. For the BX electrical connection, I drilled a hole in one end of the base. To allow for manual operation of the lights, I installed a 15-amp toggle switch hooked up in parallel with the toaster switch. A cover for the toaster base of 1/16" aluminum completed the job. A full turn of the knob sets the timer to start the cycle.—Robert Micals, Freehold, N. J.



New Ideas in Photography



These cameras give you better pictures automatically: (from left) Brownie Starmatic, Kodak Automatic 35,

How the Dependable New Electric-Eye

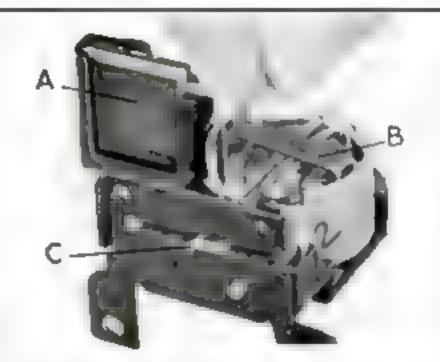
Two different systems— some picture-perfect results!

Hottest still and movie cameras today are the new electric-eye models that read the light and set their own lens openings

For dependability and trouble-free operation, Kodak engineers have created tree control systems—one for still cameras, one for movie cameras. You need two, because still cameras have larger diaphragms. They demand more power than a photocell can supply.

For still cameras: a control needle. Kodak and Brownie automatic still camera diaphragm movements take no power from the photocell. Current from the cell simply positions an exposure-control needle! And the needle position decides how far the lens will open when you press the shutter release.

The simplest of the automatic cameras working this way is the Brownie Starmatic. Shoot in bright sunlight, the lens "squints" as your eyes do.



So precisely balanced is the rugged photoelectric "brain" of the Brownie Starmatic Camera, that a human hair can be used to move the meter needle through its full range. In actual use, light on photocell (A) generates current which flows intogalvanometer B), moving the needle (C). When shutter is released, position of needle determines lens opening

from Kodak



"Picture it now-see it again and again"

Kodak Cine Automatic Turret, Kodak Zoom 8

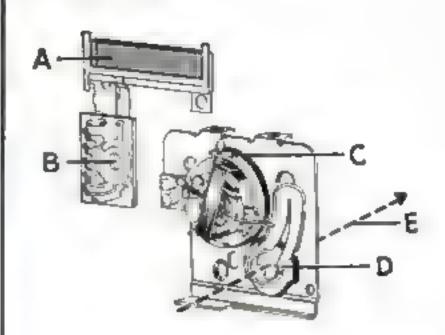
Cameras Work

Shoot on cloudy days, the lens opens up And all automatically. No focusing. You get snapshots or slides, 12 pictures to a roll Cost? Only \$36.50 at your Kodak dealer's.

The more advanced Kodak Automatic 35 Camera has an //2.8 lens, the fastest available on any automatic still camera. So it gives you more freedom in a wide range of light conditions, from dawn to sundown. For flash shots and special effects, set the camera on "manual" control and choose your own lens openings. Rapid film advance, easy loading. Costs only \$89.50.

For movies: lightweight blodes. Movie cameras have a featherweight, counterbalanced diaphragm directly on the meter needle (see box, upper right). The lens opening then adjusts continuously, as you "pan" across a scene.

With the Kodak Cine Automatic Turret Camera, f/1.9, you can follow your subject from sun



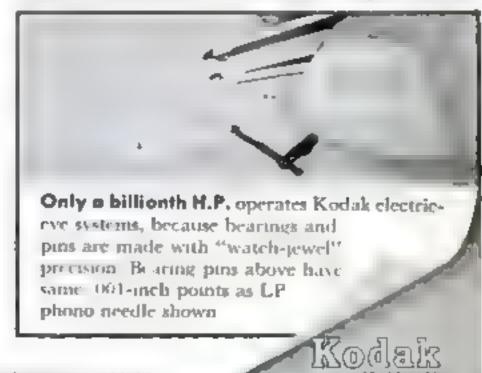
A teardrop-shaped diaphragm provides accurate exposure control for the Kodak Zoom 8 Camera. Light on photocell (A) generates current which goes through selector switch (B) and resistors for various film speeds. Current then flows into galvanometer (C) and swings diaphragm (D) to admit correct amount of light (E) to the film.

You can also use the meter independently, and lock the lens diaphragm at any setting. And it can be set for faster movie films than are now available. So it will be up-to-date for years to come. Three-lens turret gives you regular, wide-angle, and telephoto shots. Only \$124.50.

For the same dependable exposure control, with dramatic new zoom effects, choose the Kodak Zoom 8 Camera (Automatic f/1.9). You can eatch your subject in motion—then zoom in for a close-up without interrupting the action or changing your position. Zoom 8 lens also takes normal, wide-angle, and telephoto views—like a three-lens turret camera. \$139.50.

Ask your Kodak dealer for a demonstration.

Prices are last, include Federal Tax, and are subject to change without notice



EASTMAN KODAK COMPANY, Rochester 4, N.Y.

SEE KODAK'S "THE ED SULLIVAN SHOW" AND "OZZIE AND HARRIET





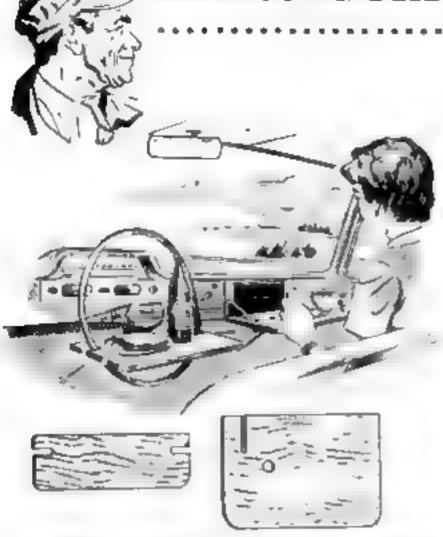
See what a difference new spark plugs can make!

Don't let worn spark plugs spoil your fun. Give your motor new pep, power and performance—with a new set of Champion marine spark plugs. Remember — a motor can't be peppy with worn plugs. And last year's spark plugs have plenty of wear on them.

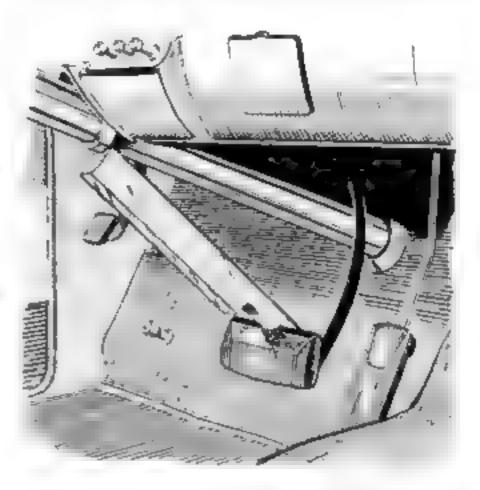
It's so inexpensive to get the sure spark you need for power-packed performance. Before you take to the water, replace those old plugs with new full-firing Champions. See what a difference new Champion marine spark plugs can make!



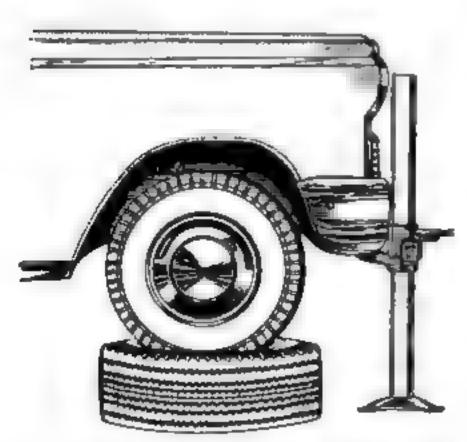
Hints from the Model Garage



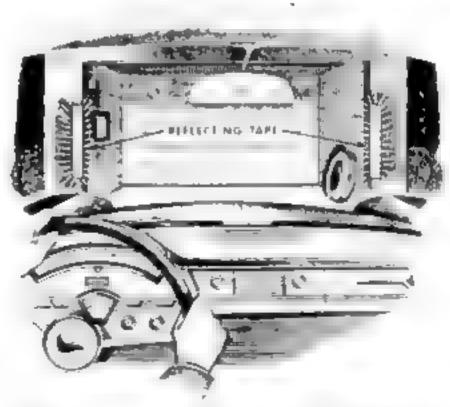
Roadside snacks can be eaten in comfort on these plywood shelves that are stored out of the way beneath the front seat. The shelf shown at left locks firmly on the rim of the steering wheel; the one at right fits over the glove-compartment door.



When rear wheels are raised with a jack, the parking brakes become ineffective. To keep the car from rolling, the four service brakes can be applied and held with a stepped stick. Cut several steps and use the one that gives most pedal pressure.

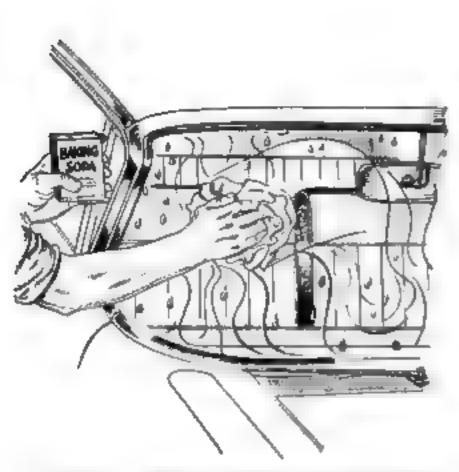


If you must work under a car supported by a bumper jack, take the precaution of placing the spare wheel beneath the wheel that's raised off the ground. If the jack should slip or topple, the spare wheel will keep the car from crushing you.

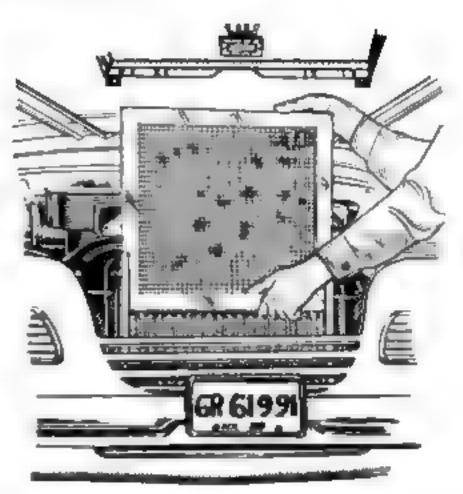


Strips of reflecting tape stuck on the edge of the garage-door opening, or on the door track if it protrudes, may prevent a scraped fender some dark night. Short strips placed at fender level are all you need to indicate clearances.

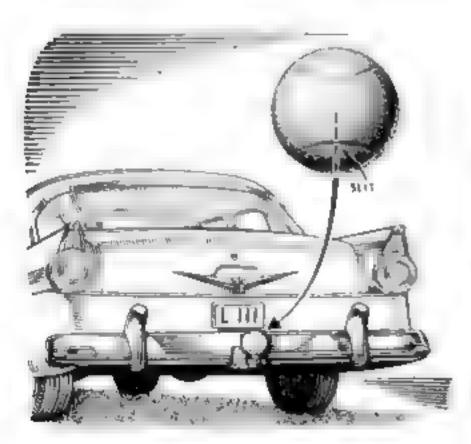
More Hints from the Model Garage



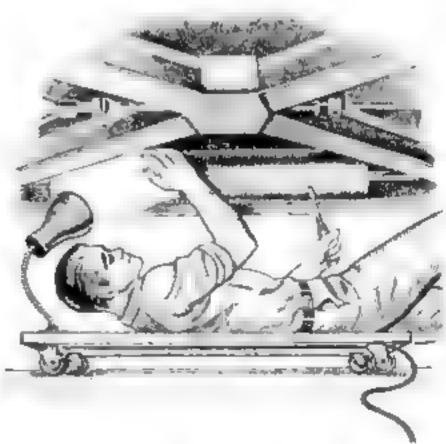
To remove oily road film from the windshield and make the glass sparkle, try baking sods. Sprinkle some on, rub it with a cloth or paper towel, and let the rain and the wipers carry it off. It won't harm the car's finish.



A removable screen to keep insects from clogging the radiator can be made from do-it-yourself aluminum. Make the screen first, then fasten two sections of aluminum channel to the sides of the radiator and slide the screen in the channel.



Cap a trailer hitch to keep it out of the weather and free from rust. Slit a rubber ball halfway through and press it over the hitch when not towing the trailer. Don't use grease; it's not needed and will cause the ball to deteriorate.



This under-car creeper has a built-in light to illuminate the work area as you move around beneath the car. The gooseneck arm can be adjusted to throw light around corners or behind chassis cross members, leaving both your hands free.

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"I 'built' my Chevy to take a hint-automatically!"

"You'd be surprised what two big brothers can teach a girl about cars—especially when they're automobile engineers. So when I went down to buy my new car, I knew what I wanted: an absolutely automatic car, one that would do everything for me short of driving itself.

"Thanks to Chevy's list of options (longest in the business, my brothers say), I've got that dream car parked in front of my apart-

ment house.

"Naturally, it's an Impala Sport Coupe. (I happen to be a fashion model, so style is extra important to me.)

I wanted V8 smoothness with the economy of a 6and Chevy's economy V8 is just the thing. And I let Turboghde* do my shifting for me. Power steering* and power brakes*, of course, and then Chevy's aix-way power seat*. Power windows* are a touch of luxury I wouldn't miss for the world, Why, I've even pampered myself with a power radio antenna[®] and a power ashtray! * Those Chevrolet people think of everything.)

"Cars just don't come much more automatic than mine. And even though my brothers are mad about sports cars, I notice they get a real charge out of driving my four-wheeled robot,"

This is just one kind of Chevrolet. There are as many other kinds as there are people: heavy-duty workhorse wagons, outright thrift cars, cars that move in utter splendor. The point is this

you can virtually custombuild your Chevrolet to suit yourself. We'd suggest a trip to your nearby Chevrolet dealer's soon. . . . Chevrolet Division of General Motors,

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> *Optional at extra cost.



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Weighty Problem



By Martin Bunn

Gus on returning from lunch. "What's it in for?"

Looking at the well-kept '54 sedan, Stan shook his head, "Wish I knew."

"Didn't Mrs. Allen tell you?"

"Oh, she told me," Stan said. "But the more she talks, the less she says. Try figuring this. She wants me to beef up the springs on the left side—because her husband has trouble starting the engine."

Gus sat down on a stool, tamped tobacco into his pipe. "Sure, Stan?"

Stan raised a hand soberly, "So help me. Sometimes the engine won't start for her husband. So because he's been gaining weight, she wants stronger springs on that side, and that will fix everything. Gus, is she related to *Gracie* Allen?"

Gus grinned. "It only seems that way.

What'll you do on the car?"

Stan chewed his lip. "See if any apring leaves are busted, I guess, and check the shock absorbers."

"M-mm. What else?"

Stan turned both hands palme up, "She sure wouldn't like riding on helper springs, or airbag boosters."

"No," agreed Gus, "But how about

checking the engine?"

A flush spread up from Stan's neck. "Honest, Gus, I'd have thought of that—just give me time to snap out of what she does to me."

Not without sympathy, Gus grinned at his helper's retreating back. He too had been the victim of Daisy Allen's free-wheeling confusion at times.

HUNCHED over a finicky automatictransmission job, Gus was startled by a tense hiss at his elbow.

"Gus! She's back."

"Checked out everything?" asked Gus, inserting a final cotter pin.

"Everything. Gas, ignition, starter cir-

cuit. That car's got to start."

Nodding, Gus wiped his hands and went to match wits with Mrs. Allen, a small, smartly dressed, pretty woman. "Mr. Wilson, I'm so glad you've fixed our car. Mr. Allen has had so much trouble—of course it always starts for me—but we don't want to trade it in until next year, so I'm just delighted that you've fixed it for now"

A bright smile signaled Gus that it was time to speak. "Not exactly, Mrs. Allen. We can't find anything wrong." Resisting an urge to cross his fingers, Gus added: "Suppose you tell me what it

seems to be."

"It's James, I mean, he has all the trouble. Yesterday at a gas station the engine just would not start, and he had to leave the car. A friend drove me there and of course I just turned on my key and off I went."

"Has it happened

often lately?"

"Seven or eight times. This morning he needed the car in the city. He tried and tried, but it wouldn't start. I'd have been glad to do it for him, but he was so upset he simply ran off. But it started right away for me. It's his weight."

Gus shook himself inwardly. "Mrs. Allen, why do you say it's his

weight?"

She flashed him a bright smile. "Don't

you see? It only happens when he's alone in the car. And it only began since he's gained weight. With all his weight on one side—of course I don't know much about engines, but mightn't that unbalance it or twist something?"

"It happens only when he's alone, not

when you're both in the car?"

"That's right, I often go to the station to meet him. Of course I stop the engine, but I leave the radio on. Then when he gets off the train, I slide over and let him drive. He never has any trouble, because I'm on the right and help balance things."

Gus breathed deeply. "Mrs. Allen, I'd like to check your car again, but first I want to talk to your husband. If it should happen again meanwhile, call me and I'll come over"

Daisy Allen wriggled into the driver's seat and switched on the engine. It purred obediently. "I'll do my part too, Mr. Wilson."

"Your part?" asked Gus.

"Of course. I'm putting James on a strict diet, starting tomorrow."

NEXT morning the phone rang early at the Model Garage.

"This is Jim Allen," a grumpy voice announced. "You checked my car yesterday. It's dead in traffic in Station Square. Police won't let me catch my train until it's towed off."

"I'm on my way," promised Gus.

The sight of the traffic snarl at the railroad station made Gus wince guiltily. The police helped him jockey the wrecker to the stalled car, where he found an angrily impatient customer

"Chap cut in front of me," explained Allen, a rotund and peppery little man. "Sudden stop killed the engine. Been standing here ever since"

"Think you flooded the engine?"

"Had this car six years. Know better

than to flood it. You try "

Silently Gus got in. The ignition key, one of a big bunch, was still in the lock. He tried the starter, then floored the throttle while cranking, to clear out any excess gas. There wasn't a pop of response from the engine.

"Tow it away before I get a ticket," ordered Allen. "I've got to go."

Reaching in, he yanked out the ignition key, detached it from the score or more on the chain, gave it to Gus, and stalked off

Gus pocketed the key and turned to hitching up the wrecker, while rush-hour traffic wove parentheses around him.

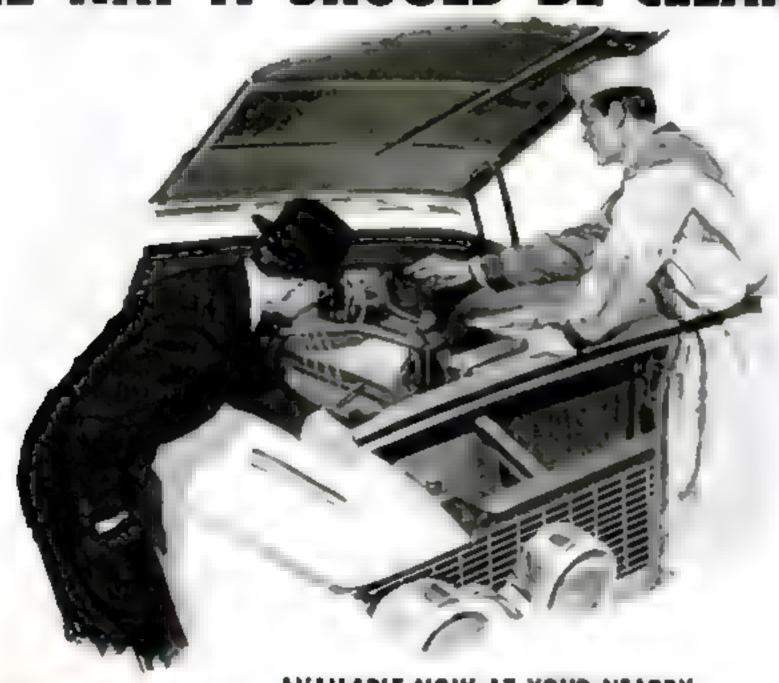




DOLLAR: Father of our dollar was the Spanish pero, used widely by colonists here and called by them a "dollar" after the German "thaler," "Pieces of eight" referred to the peso's value: eight Spanish "reals." When reals were scarce, people broke their pesos into quarters—each worth two reals, or, in slang, "two bits."

The first US silver dollar minted in 1794 had two ribbon-entwined pillars on it. You see them now like this. \$.

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BURETORS

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"Don't bother, Mr. Wilson," a lilting voice called out. "I'll drive it."

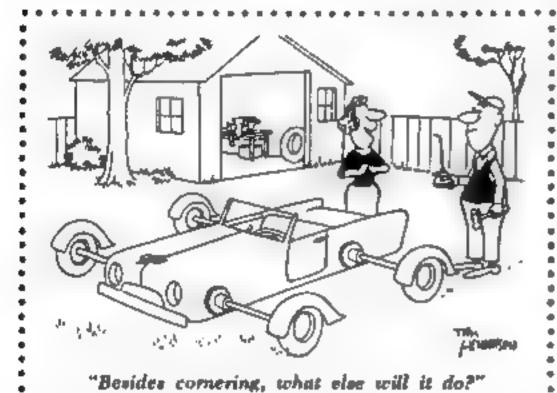
Gus almost dropped the tow hook. "Mrs. Allen! How did you get here?"

The lady alighted from a taxi in midstreet, "My friend Judy Stone was driving by when James got stuck. She phoned me, and I hurried over."

"It's no use," Gus protested, "I just tried it, Mr. Allen wants it towed away

before he gets ticketed."

Daisy Allen, now in the driver's seat, rummaged in her handbag. As a policeman approached ominously, she pulled out a tiny keycase.



"Stay put, Mrs. Allen," said Gus hastily. "I'll have you in tow in . . ."

Mrs. Allen's small fingers inserted and turned the key. The starter surged. The engine roared into action.

Gus fled to the wrecker.

SPOTTING Mrs. Allen as she drove in, Stan deftly vanished. Gus courteously opened the car door for her.

"There, Mr. Wilson. Now you can take care of everything," she said.

"Uh—yes, after I find out why it started for you and not for me."

She peered up at Gus. "You're taller, but you weigh as much as James. That's why. Oh, I'd better leave my ignition key with you."

"Mr, Allen gave me his."

"Not that terrible bunch he carries, I hope. He needs all those keys at the plant, but they always put holes in his pockets. If he's forgotten—"

Smiling patiently, Gus held up the ignition key Jim Allen had given him

DETERMINED to leave no diagnostic stone unturned, Gus himself checked the fuel system from tank to carburetor, inspected the points, tested the plugs, condenser, and under-hood connections. He squirmed under the dash with a light to see that ignition-switch connections were tight. They were, As Stan had said, this car had to start.

As Gus crawled out, the light fell on a crazy pattern of scratches under the ignition switch, caused no doubt by

> Allen's heavy bunch of keys. Keys heavy enough to tear

holes in pockets!

Gus inserted the single key, started the engine. Then he hung the droplight in the eye of the key and swung the light gently.

The engine cut out at once Late that afternoon, James Allen appeared at the Model Garage. "Got an early train," he explained. "Found the trouble yet?"

"It was a worn ignition switch," said Gus. "We put in

a new one."

"A worn switch? How come it always worked for my wife?"

"That's what stumped us at first," said Gus, "Your wife left her keys with the car, and with them the ignition checked out fine. But your heavy bunch dragged on the ignition key so hard that it wore the switch innards, and finally moved them apart enough to break the circuit."

"I'll be darned. Yes, when she meets me at the station she leaves her key in, and I use that. Why, you could have driven my car away instead of towing it!"

Gus cleared his throat. "She did," he said. "There'll be no tow charge."

"Sorry I was gruff at the station," Allen went on. "Besides getting stuck, I'd had two prunes, dry toast, and black coffee for breakfast. Now I'll probably get two lettuce leaves and a peach for dinner. Say, what should I tell my wife about all this?"

"Tell her," suggested Gus, "that we found your overweight on your key chain. She can take you off that diet."

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In about a half-second, Bowser is going to take off like a jet. That's real starting power! Your car can start just as quickly with a Delco DC-12, the dry charge battery that's built to take it and dish it out. Delco's the battery you find in nearly half of today's new cars. It delivers the full, fresh power you need for today's high compression engines and multiple electrical loads. Delco batteries are a product of Delco-Remy, manufacturer of a complete line of automotive electrical parts. Your Delco dealer is the man to see for . . .



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6- AND 12 VOLT MODELS. DELCO BATTERIES ARE ANOTHER RELIABLE GENERAL MOTORS PRODUCT
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Short Cuts and Tips

Centering Jig for Woodwork

A V BLOCK, made from a short length of two-by-four, comes in handy for many woodworking uses. You can use it to hold dowels, rods, or pipe for drilling. With a square, it will help locate centers for lathe work or drilling. Cut the block by making two passes with the saw set at 45 degrees.—

Paul Corey, Sonoma, Cal.

To make a glue joint invisible, wipe off the squeezed-out glue and sand the wood while the glue in the joint is still tacky. The wood dust will blend with the glue and act as a filler for small crevices.

—J. C. Roby, San Diego, Cal.

go, Cal.

Leveling Stair Stringers

It's no trouble to level stair stringers if you install two lag screws on the bottom of each stringer before you set them in place. In addition to making the stringers adjustable with an end wrench, the lag screws will hold the stairs off a concrete floor and keep them dry.—Allen Hanson, Ontonagan, Mich.

Drill Block Stays Dustfree

Dust won't accumulate to clog the holes of this homemade drill block. It is made of twin blocks joined by spacer cleats at the ends. Drills are held vertical in holes in the top section, and rest on the bottom section. Dust can be blown out easily from between the two sections.—

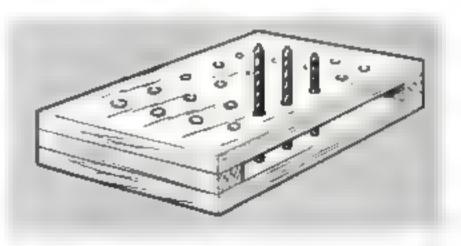
G. E. Hendrickson, Argyle, Wis.

When using strips of sandpaper like a shoeshine cloth over corners or round work, the strips often tear before the sandpaper is worn out. You can prevent this by sticking cellulose tape on the backing.—I. R. McCaffrey, Malibu, Cal.

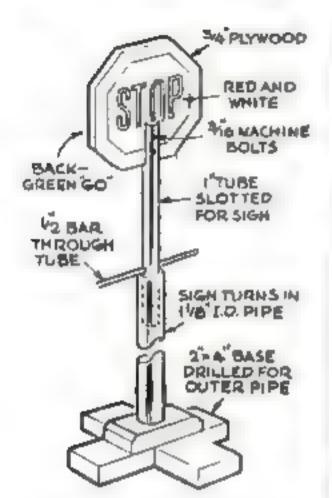


Chaining a Chuck Key

This simple method of chaining a chuck key permits the key to be turned without wrapping the chain around the key. The chain is bolted to a loose-fitting washer which is slipped over the shank after the handle has been removed. The handle is driven back in place afterwards.—H. J. Gerber, Sullicator, Okla.



Short Cuts and Tips

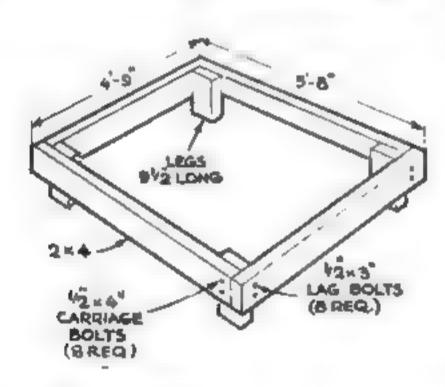




Play Stop Sign for Youngsters

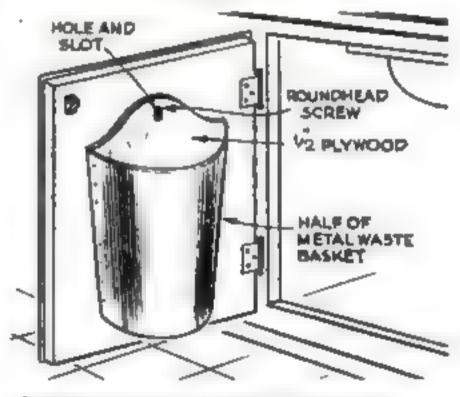
This stop sign, which I worked out for a nursery school, has worked well and is sturdy enough to resist abuse from young children. Dimensions are arbitrary, depending on the size of the children. The sign is easy to take apart for storage.—

D. A. Williamson, Glen Ellyn, Ill.



Fast Bed-Making

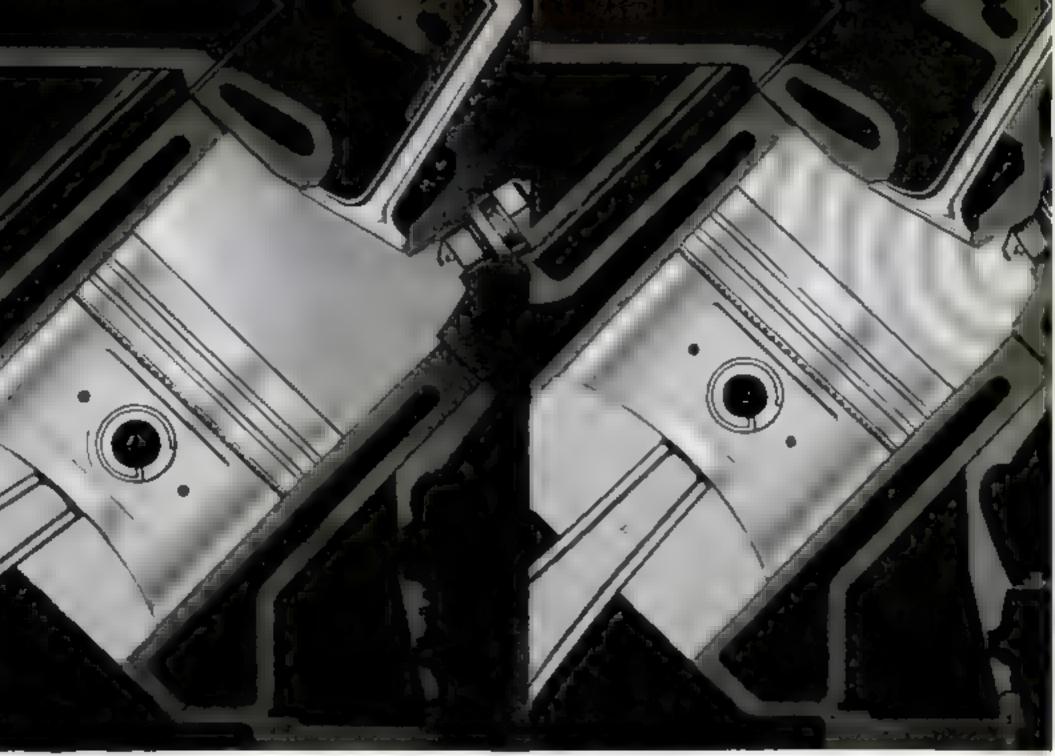
NEEDING an extra bed in a hurry, I measured the bottom rails of a spare bed-spring, then went to the lumberyard. I brought back some bolts and two 12' two-by-fours, In less than an hour, I had sawed each of them into four lengths, with no waste, and built this Hollywood bed frame.—Hy Wilson, Hudson, Ind.



Cabinet-Door Waste Basket

A waste receptacle for the inside of a sink-cabinet door can be made from a metal basket cut in half. Nail it along the edges to a piece of \(^1/2''\) plywood. For easy removal, make a slotted hole in the top of the plywood to slip over a roundhead screw as shown above.—

Victor H. Lamoy, I pper Jay, N. Y.



OCTANE'S TOO LOW when combustion takes place too soon, causing engine to "knock."

OCTANE'S JUST RIGHT when combustion takes place at right moment, giving quiet, powerful performance.

What octane really means

"Octane" is a number which petroleum engineers use to rate a gasoline's freedom from "knock" or "ping" when it's burned in an engine.

Knocking occurs when the fuel-air mixture in the combustion chamber of a cylinder explodes prematurely or "detonates." It's usually caused by gasoline too low in octane, and it can result in loss of power and damage to expensive engine parts.

When the octane is just right, the gasoline burns smoothly and prevents knocking. Your engine gives you all the smooth, quiet, powerful performance it can deliver.

But octane is only one of the many properties of a good gasoline. For example, quick starting, smooth warmup, maximum power, best performance, top economy and freedom from vapor lock are all affected by climate and altitude which vary in different areas.

Through selective blending, Texaco's gasolines are "100% climate controlled." This means that Texaco changes the blends not just seasonally, but every month of the year for 26 different climate and altitude areas throughout the country.

That's why, when you fill up with topoctane Sky Chief Su-preme with enginesaving Petrox, or famous regular-price Fire Chief gasoline, you can be sure you're getting the right blend for top performance

and economy. You drive with more pleasure...and save for good measure!



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MUW, PUBLITUE PRUTEGITUM AGAINST KUST!





PROOF OF BETTER ADHESION — Rusted metal sheets were coated with primers and finish coats and exposed to weatherometer at 95 degrees and 95 per cent humidity for 300 hours. They were then subjected to severe bending. Ordinary Primer cracked and broke away from surface. RUSTMASTER showed little sign of stress, revealing far greater flexibility and adhesion.





PROOF OF BETTER ENDURANCE — In salt spray test, metal panels were coated with primers and finish coats and scratched through to bare metal. Panels were then subjected to continuous salt spray for 500 hours. Ordinary Primer had severa blistering and under-film corrosion. RUSTMASTER restricted corrosion to scratched area, proving higher corrosion-resistant qualities.

New paint penetrates deep down into metal pores, forces out corrosive moisture and air

RUSTMASTER, the paint developed to combat the \$6 million annual corrosion losses of industry, can now beautify and lengthen the life of metal surfaces in and around your home.

RUSTMASTER can be brushed right over rusted surfaces—penetrates deep down into metal pores, driving out corrosive moisture and air.

Secret to the remarkable protective action is a special surface wetting additive.* Operating on a principle similar to modern detergents, RUSTMASTER forces right through rust layers to the metal beneath.

RUSTMASTER PRIMER is easy to apply by brush or with the convenient spray can. It dries overnight ready for finish coat,

Insist on the finest in metal protection. Ask your paint dealer for RUSTMASTER, the paint proved in industry. Primer and nine attractive finish coats are available plus RUSTMASTER GALVANIZED PRIMER for aluminum and galvanized metal.

*Patent Pend.



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The Facts Behind Those Corvair Stories

If ontinued from page all.

defense, nevertheless, in a recent talk by Chevy boss Ed Cole. He pointed out that many buyers of U. S. compacts may have—unrealistically—anticipated mileages like those of the smaller and lighter imports. "When properly tuned," he went on, "the Corvair will do as well on fuel economy as any of its competitors, and a darn sight better than one." It will deliver, he added, about 18-22 m.p.g. in the city, and 25-26 on the highway. (For comparison: the PS Corvair, carefully maintained and with a manual box, averaged 23.43 m.p.g over 10,360 miles.)

How many bugs are too many? Corvair people admit informally that they had a rough time last fall. But they insist, convincingly, that the major problems were licked by the time production was resumed in December after the steel strike. They point out two subtle psychological factors that made their trou-

bles doubly difficult:

• Public interest in the car virtually guaranteed that any bugs would be widely known. The troubles that beset even face-lift models never win public attention, but the unconventionality of the Corvair design meant that the autowise public would be watching closely.

• The anticipation with which the U.S. compacts were greeted also set the stage for trouble. Just as many people expected the cars would cost less than they did, many expected they would give better nuleage than they have. And Detroit knows well that once a new owner expends his initial pride of ownership, he can grow so sour about his purchase that nothing about it suits him.

Outsiders' viewpoints. Many technical men working for companies other than Chevrolet display a measure of sympathy, "Most of it could have happened to any of us," one engineer observed, "There just isn't a new model released that doesn't show up sick in one way or an-

other."

"Corvair isn't the first car to have bugs," a Chrysler engineer confided, "and it won't be the last. In recent years Buick has had transmission troubles, Oldsmobile had a cross-firing headache, and Ford kept wiping the lobes off its camshafts. One year we had so many rain leaks that it was a good thing we weren't building boats—we'd have drowned all our customers!"

But a note of mildly malicious satisfaction creeps into some comments. Said a Ford man: "On carburetor icing, I figure that the boys at Chevy just had too many other things to think about on that unorthodox system. They put in so much time getting that remote choke setup to work, in getting low-speed flexibility, and in trying to get proper mixture distribution to each cylinder that they just didn't think about icing. I suppose it's understandable—none of us has had serious icing problems for a long time."

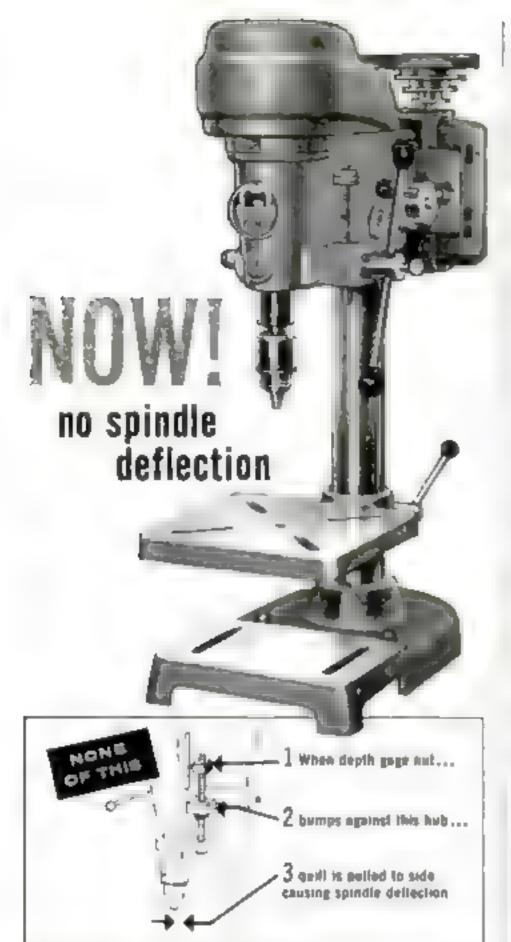
Or this tart observation, from a Chrysler man: "The only trouble that I'd really fault them for is that fan belt. They should have known they were asking for trouble. It's one thing to get a weird rig like that to work in handmade test cars that are maintained by topnotch mechanics. And a totally different thing to expect the same results from production jobs, with varying tolerances

and little or no maintenance."

How much did the bugs hurt? No one can be sure except the top Chevy brass, who aren't saying. It stands to reason, though, that the bugs have been at least one reason why the Falcon has moved out ahead on sales. But plenty of other factors could also be at work here: Falcon's styling, its familiarity of feel, a different merchandising approach, and its use of an economy-biased axle ratio.

Not that Corvair has been the only victim of bugs, Falcon, though relatively trouble-free (as might be expected from an essentially conservative design) has had its little crises—including a few cases of exhaust leakage from the ungasketed block-to-manifold joint and, quaintly, a rattling dipstick. More serious have been owner complaints about crosswind sensitivity and unwillingness to climb hills in high. The latter trait, an inevitable by-product of the gas-hoarding 3.10-1 axle-ratio, has led Ford to install more nimble but thirstier 3.56:1 gears in Falcons to be sold in hilly areas like Cincinnati and San Francisco.

Valiant, in its turn, has also been wrestling with some production-line problems. The most common owner complaint is said to be imperfect sealing,



South Bend's design eliminates the major cause of inaccuracies common to all drill presses—spindle deflection resulting from depth gage pressure. There is no depth gage collar on the quill. Travel of the quill is controlled by an exclusive Rack Type Depth Gage that limits the rotation of the quill feed shaft. Write for more details about South Bend's exclusive features.

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The Facts Behind Those Corvair Stories

leading to persistent rain leaks. Other complaints mention steering-column chatter, progressive steering stiffness, vent-door latching, and a transmission linkage that has occasionally left the shift lever limply disconnected.

Finally, for perspective, it should perhaps be noted that plenty of earlyserial Corvairs are on the road, eating up miles and making their owners happy As evidence, consider the saga of the PS test Corvair, traded in in mid-November to a dealer. After the bug rumors became widespread, we traced its subsequent history, because it had had 10,360 hard miles in four weeks. The PS Corvair had been sold by the dealer to a wholesaler, wholesaled a second time, bought by a dealer in New Jersey, and, in late February, retailed to a U.S. Army sergeant at Camp Kilmer, N. J. Somewhere along the line its speedometer had been jimmied back to a coolly dishonest 1,800 miles. But despite the unwarmed air scoop, the two-stroke parking brake, and other original details, and despite the little car's rigorous early life, the sergeant was tickled with his buy, "She runs just fine," he reported. "No complaints at all."



EAST GERMAN JET. Four-engined BB-152, designed to compete with the French Caravelle, has safety belts concealed in zip compartments, molded foam-rubber backrests, an emergency oxygen mask facing each passenger, and Dresden china dinnerware. It seats 57, and cruises at 480 m.p.h.

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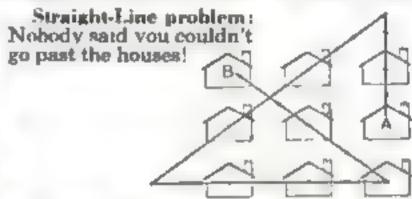
Answers to

PS Puzzlers on 26 and 28

Shangri-La: Curiously, the mathematicians found that most people would bet either 50 or 99 cents. Both of these are bad choices—especially when you consider the community as a whole. For if all Shrangri Layans bet 50 cents the philanthropist would have to toss a coin to determine who got the dollar in each pair. Half the time a citizen would lose; half the time he'd get the dollar—but since he loses whatever he put in the envelope to begin with, he nets only 50 cents. In the long run his profit would be zero.

On the other hand, if all Shrangri-Layans bet 99 cents, half the time each citizen would lose it; half the time he'd net a penny. Very disastrous for Shrangri-La's economy: Everybody loses in the end.

The best solution—since it's not specifically forbidden—is to bet nothing. If the whole community never put any money in the envelopes each citizen would still average a fifty-cents-a-day profit. (The days he gets nothing balance the days he gets a dollar.)



True-false puzzle: Assume Lefty did it. Then each of his statements is false. Okav, now look at Spike's statements, Each of his then becomes true—a contradiction of the original qualification. So Lefty's innocent.

Assume Spike did it. Now go back and test Lefty's statements again. 1) and 3) become true and 2) may be true or false—but we better call it false or else we violate the qualification again. Now look at Red's statements. If we agree that Lefty's statement 2) is false, everything Red says is true—again we violate the original qualification. So Spike can't be the murderer either. Red dun it.

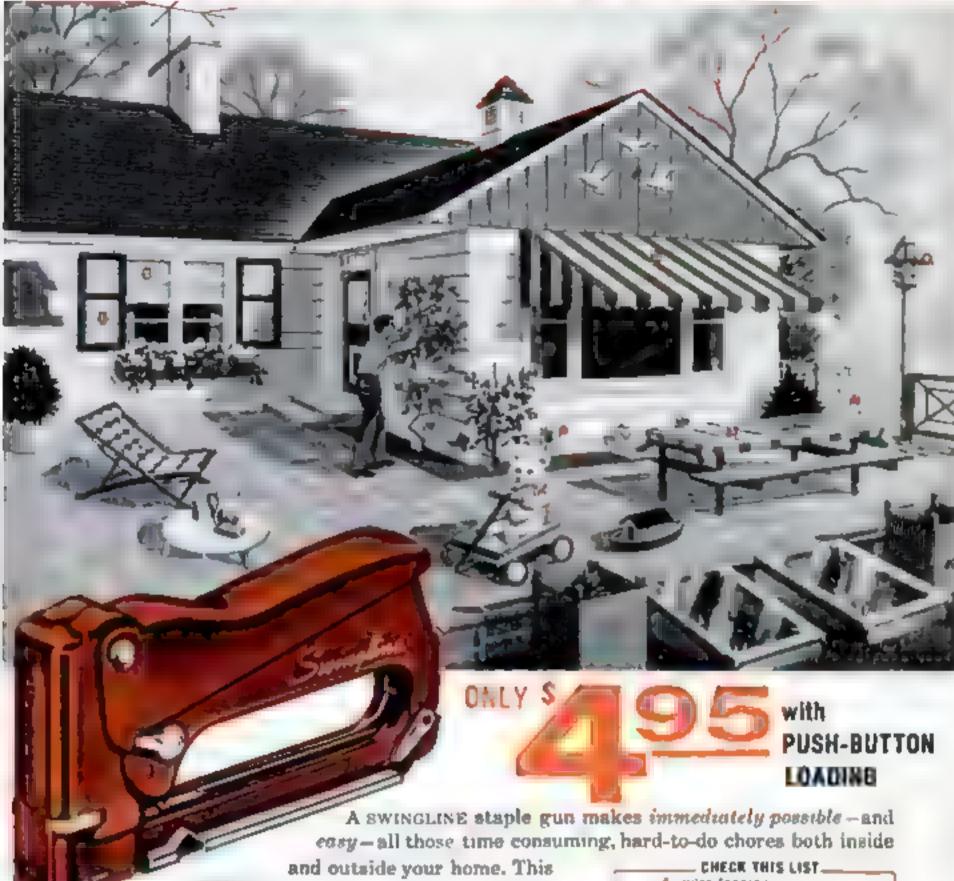
Vinegar-water: The proportions are the same. Suppose for convenience we say each glass contains three teaspoonsful. Let v = teaspoons of vinegar; w = teaspoons of water

After the first transfer the amount in the vinegar glass is 2v; the amount in the water glass, 3w + 1v. Now in removing a teaspoonful from the vinegar-water mixture and pouring it back to the vinegar glass we transfer 1/4 (3w + 1v). The ratios come out alike

Vinegar Glass $2v + \frac{1}{4}(3w + 1v) = \begin{vmatrix} 3w + 1v - \frac{1}{4}(3w + 1v) - \frac{1}{4}(3w + 1v)$

Traffic ticket: He felt the exhaust tailpipe. It was cold, so he knew the car had been standing more than five minutes. In mild weather, it would stay warm that long.

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Fighting the Fire That Won't Go Out [Continued from page 63]

above ground can change their course. A section that is blazing hotly one month may be stone cold the next.

Quenching the inferno. Understandably, the cheapest remedies were tried first. The burning garbage was drenched, then smothered with a blanket of wet clay. No good. The fire was already in

the coal underground.

Then, flooding Over the years since the fire started, 800 holes have been drilled 100 feet or more deep into The Patch's hidden inferno. Many were test bores, to gauge the extent and ferocity of the fire. (Temperatures of 930 degrees were recorded only 30 feet below ground, but several times the chains melted and the thermometers were lost.) To other holes came fleets of dump trucks bearing tons of soaking-wet silt.

The idea was to pipe silt through the bore holes and fill the porous earth solid This would at least seal off the fire, preventing further spread, and might choke

it off and quench it completely.

The silt helped some—the schoolyard cooled off. But in other directions the fire sneaked around the silt barriers.

Dousing the fire with water—the obvious remedy—turned out to be impossible. Fall Brook curves across The Patch, and a hole punched through its bed would divert the stream underground. This would raise the local water table so high that mines all around would be destroyed, basements would become swimming pools, roads would be washed away and the area's sewer system totally wrecked. But the water level still would not reach high enough to extinguish burning seams that extend up the hillsides.

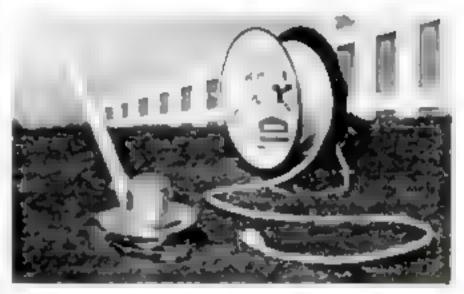
People in peril. Human tragedy struck The Patch in 1952. Mr. and Mrs. Patrick Collins were killed in their sleep. Diligent detective work proved that the fatal gas came from the fire, not from a leaky utility main.

Visitors to The Patch are appalled that people continue to live with death always underfoot. They do, 1,200 of them.

For a time, many a father slept in two-hour stretches. He'd set the alarm clock two hours ahead, get up when it rang, wake each member of the family to make sure nobody felt sick, then ad-

SAVE \$750 Combination Special*

Porter-Cable POWER GRASS TRIMMER WITH CORD & REEL SET



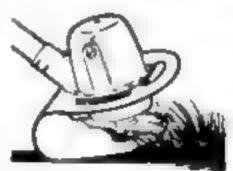
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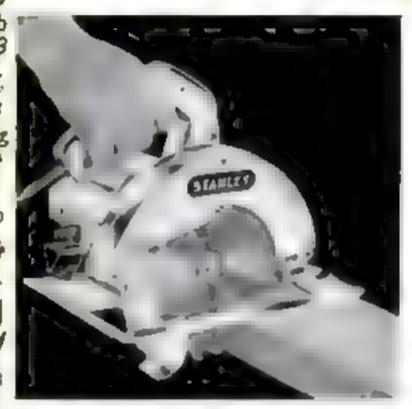


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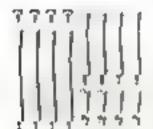
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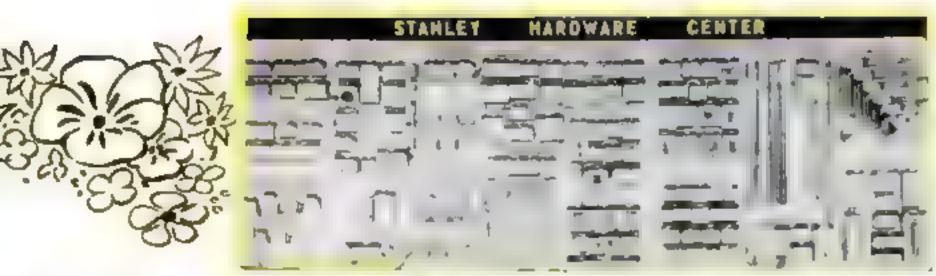


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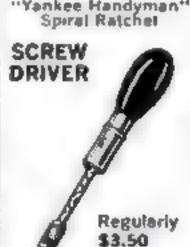


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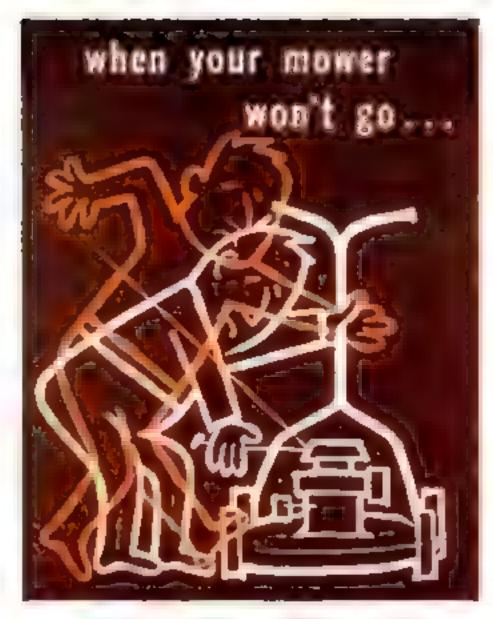
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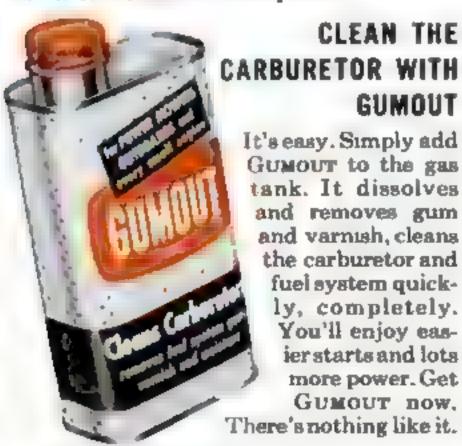
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GUMOUT DIVISION PENNSYLVANIA REFINING COMPANY CLEVELAND 4. OHIO Fighting the Fire That Won't Go Out vance the alarm another two hours and go back to bed.

The Patch sleeps easier now, thanks to the 24-hour vigil of Carbondale police and state mining officials. The state mine inspector for the area—a tough, smart, and spry 72-year-old Irishman named James Munley—supervises a staff of three checkers. At least once a day, a checker quietly enters the basement of every home with a shielded candle to gauge the carbon-dioxide content and a tube of chemical that turns green when carbon monoxide hits it,

Thanks to these extraordinary precautions, no one has been killed since the Collinses, although checker Martin Campbell one night dragged an unconscious woman into the street and out of the very jaws of death. The checkers have lost count of the number of times they have raced up cellar stairs to pound on bedroom doors and yell, "Cover up! We're coming in!"

Dig it out. The only way to make Carbondale a safe place to live and an attractive site for new industries is to strip-mine all The Patch's coal from aboveground. But 400-odd homes, garages, and stores—worth \$2,000,000 were in the way. Nobody had that kind of money, certainly not in northeastern Pennsylvania—until Uncle Sam came along. City, state, and federal officials patiently cooperated on a plan. They declared The Patch a slum (whether you'd consider it a slum or not depends on where you live, but it's plainly no executive-type suburb); thus the government will pay nearly all the bill, as part of the U.S. slum-clearance program.

The Carbondale Redevelopment Authority is now buying up the houses and relocating their occupants (some will move into new duplexes being built on the other side of town). This painful job taxes the patience of even so understanding and friendly a man as Authority director T. C. Toolan. Most of the families do not want to leave.

It will take three years to clear The Patch. But enough land is free already for digging to begin.

The big shovels. Strip-mining is an awesome spectacle—gigantic machines precariously clinging to the brinks of chasms while they claw at the precipices



on a HARLEY-DAVIDSON Duo-Glide

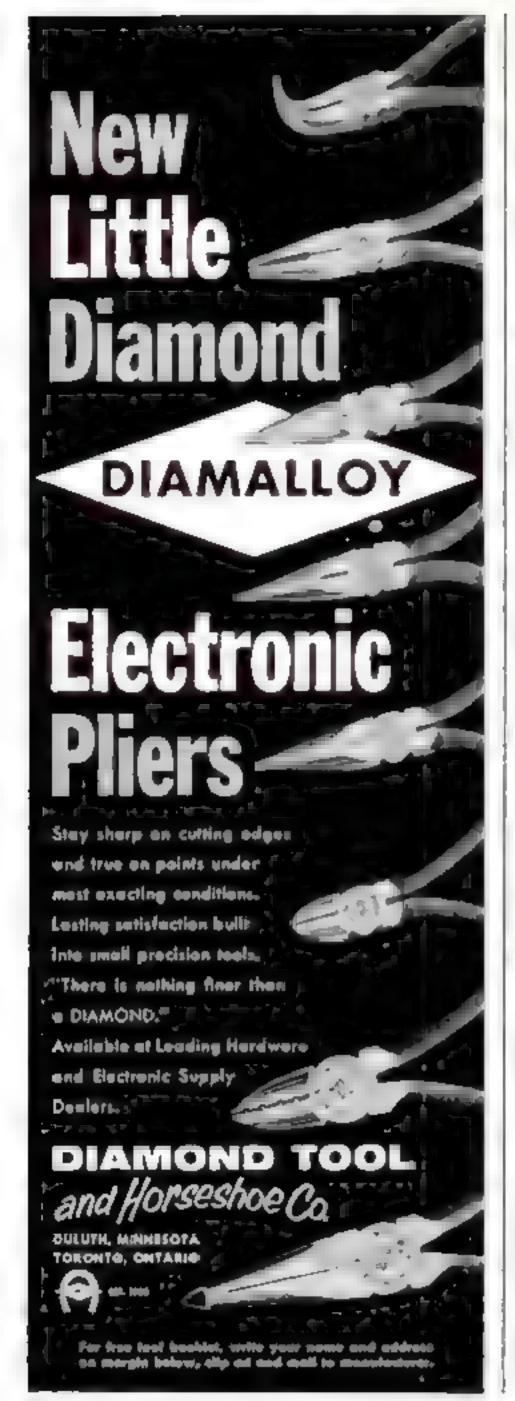
A gal, a beach and a Duo-Glide — it's the perfect combination for a perfect day. But then any destination is more fun getting to on a Harley-Davidson Duo-Glide.

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Fighting the Fire That Won't Go Out they overhang. The operation in The Patch is bigger than most, and spiced with extra hazard.

Mammoth trenches, each 125 feet deep and 250 feet wide, big enough to bury a cargo ship, are being chopped across The Patch. The first trenches, which edge the area to cut off spread of the fire, will be filled with dirt dug from the next ones alongside, and so on until every inch of ground is turned over.

The earth-moving job is staggering-

4,000,000 cubic yards.

The "overburden" of rock and dirt that lies atop the coal seams is hacked away by a gigantic dragline—as big as a house, with a 10-ton toothed bucket dangling from a boom the size of a bridge. It moves to position by hitching itself along like a man on crutches: up on the "crutches," swing forward (or back), down on the circular baseplate again. One man operates it, casually flipping hydraulic-control levers to scoop 10 tons of rock as precisely as a brain surgeon separating nerve fibers.

Working in souter. When the dragline exposes a coal seam, a power shovel—the kind that digs excavations for buildings—crawls down into the canyon, and spades the coal into rugged Euclid trucks. They work in a chest-high pond of water, to keep fire heat from burning up treads,

tires, chassis—and men.

along.

Every bit of coal is being dug out. What's burning gets doused with water, then trucked up the mountain to a dump (far from anything combustible). The rest goes to the breaker for sale.

The return on coal sold will more than cover the cost of mining it, even under such hazardous conditions. So the Hudson Coal Co. will pay a small royalty for the privilege of getting within power-shovel reach of coal that it has owned all

When the last dragline lurches away and bulldozers plane the chopped earth, 10 years from now, The Patch will be reborn. A few houses will come, perhaps a ball park, but mainly it is to be prime land for the new industry Carbondale so badly needs. It will be naked and raw, but fireproof, solid, and safe—a proper monument to the perseverance that overcame the strangest disaster that ever struck a city.





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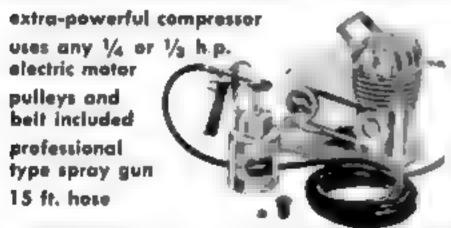


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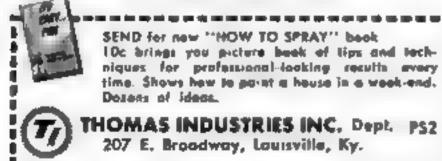
Tough-hearted compressor keeps a steady 18 lbs. pressure In the spray gun. Sprays exterior and interior oil, latex paint, water-soluble, multi-color, stains, lacquers, enamels, varnishes, insecticides, etc. Precision made, guaranteed for a full year.

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Probing Secrets of the Universe

(Continued from page 103)

out brightly—up to several hundred miles. They have carried aloft a fourinch telescope, spectrographs, cameras, other instruments. Findings are telemetered to the ground, or retrieved from parachuted nose cones, Their brief glimpses, before they plunge back to earth, have sufficed for fascinating discoveries reported by Dr. Herbert Friedman and fellow scientists of the Naval

Research Laboratory.

Around the star Spica, rockets find a mysterious aureole of blazing light, extending nearly a quarter of the way acrosa the heavens. If human eyes could see it, the luminous display would be a brilliant feature of the night sky, outshining moon and stars. Actually it glows with invisible far-ultraviolet light—detected and mapped by rocket-borne instruments called photon counters. This aky glow, and several others like it, were a recent surprise discovery. Seeking their unknown cause may reveal unsuspected physical forces at work in the stars.

From a 123-mile height above White Sands, N. M., early last year, a special camera in an Aerobee-Hi rocket took the first photo of the sun by far-ultraviolet light. Above-the-air observations show that it shines more brightly in this "color" than any other. They also detect bursts of powerful X rays from the sunpossibly a principal cause of radio blackouts, for which the sun's ultraviolet rays

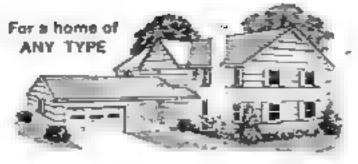
have been blamed before

These exploits illustrate what may be sky observatories' greatest gift to astronomers: For the first time, they open to view the whole gamut of the stars' electromagnetic radiation, mostly absorbed

by air and undetected on earth.

Through most of astronomical history an observer's view of space has been limited to an "optical window," encompassing the visible and near-visible rays that penetrate the atmosphere. Another peephole into space, the atmosphere's "radio window" for the shortest radio waves, was discovered in 1932. Since then, radio astronomy has expanded our knowledge of the universe as much as past centuries of optical astronomy. Now, all at once, sky platforms fling open every other kind of "window," All the hidden radiations leap into view-





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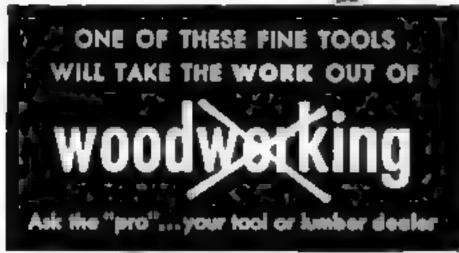
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Probing Secrets of the Universe

gamma rays, X rays, the far ultraviolet, the far infrared, the longer radio waves, Suddenly astronomers find utterly fabulous advances within their grasp. A golden era of discovery has opened for them

Satellite observatories, operable 24 hours a day in night-dark space, will prolong the view that rockets get only fleetingly, Multipurpose U. S. and Russian satellites already have made some ultraviolet and cosmic-ray observations. Coming next and soon are satellites designed especially for astronomy. Plans to launch a series of them, beginning in 1962 or 1963, have been announced by the National Aeronautics and Space Administration. Tentative designs, of oneto two-ton weight, wield telescopes of 24-inch size and up. Pressing every advantage of airless space, astronomical satellites will have optical telescopes for the ideal seeing by visible light; and a varied array of instruments to pick up the "new" radiations, observable only above the air

What satellite telescopes see can be relayed directly to earth by TV technique—the method now considered most promising. Or photos could be made, for later radio transmission.

Tempting targets for space telescopes include the mysterious Great Red Spot on Jupiter—more of a mystery than ever, since grinding and rumbling radio noises were recently traced to its vicinity; and Saturn's famous rings, once thought to be made of rock fragments but now believed to be of snow. Satellite observatories are expected to spot nonsolar planets. quite possibly inhabited by intelligent beings, that are suspected to be orbiting around some nearby stars—like one called 61 Cygni-from wobbles in those suns' motions. So far will space telescopes outrange earthbound ones that they may see to the very edge of the

Astronomers themselves will later eye the skies from manned satellites. And the ultimate step, officially announced as a long-range NASA objective, will be an observatory on the moon; it will offer a stable foundation for a telescope of unlimited size, with no atmosphere to hamper observations.

The moon, meanwhile, has become

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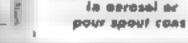
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Probing Secrets of the Universe

the first conquest of a rival kind of sky adventuring—"go-there-and-see" astronomy. What the moon's far side looks like was finally revealed, last October, when Russia's Lunik III space probe photographed it at close 40,000-mile range, developed the photos, and radioed them to earth—a dazzling exhibition of rocketry and instrumentation. Coming U. S. and Russian astronomical expeditions into space may be expected to reconnoiter Mars and Venus, land seismographs and other instruments on the moon, and, later, bring back tangible samples of the surface of the moon and planets.

But so many celestial objects of interest lie outside our solar system—and beyond the imaginable range of a "go-there-and-see" space vehicle within anyone's lifetime—that telescopic observation will remain the major tool of astronomy. And it will reach its highest development, score its greatest discoveries, in the new observatories above the

atmosphere.

How sure astronomers are of this is dramatically shown by a recent change of plans for the great Kitt Peak National Observatory under construction in Arizona, Its long-range program was to have provided it with a telescope of several-hundred-inch size, perhaps the world's largest. Now that has been shelved, the National Science Foundation reports, in favor of "a new and exciting project, the design, construction, and operation of a large orbital (satellite) optical telescope."

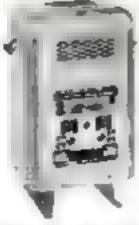
The national space telescope will be a grand-scale one. Going beyond plans for early astronomical satellites, it is expected to be of 50-inch size. It will make observations on command from the ground and communicate them back to earth. Put into orbit at about 22,000-mile altitude, so as to circle the earth in just 24 hours, it will keep pace with the earth's rotation—and hover permanently above its control point on the ground.

Planners emphasize that the Kitt Peak space telescope is years away. It will be enormously expensive. But they have high hopes that it will eventually be the national observatory's principal, spectacular piece of equipment—available, like Kitt Peak's other telescopes, to all qualified U. S. astronomers.

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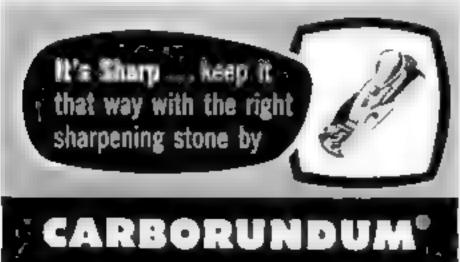
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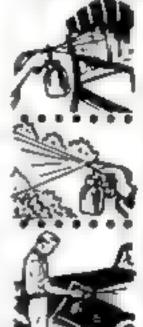
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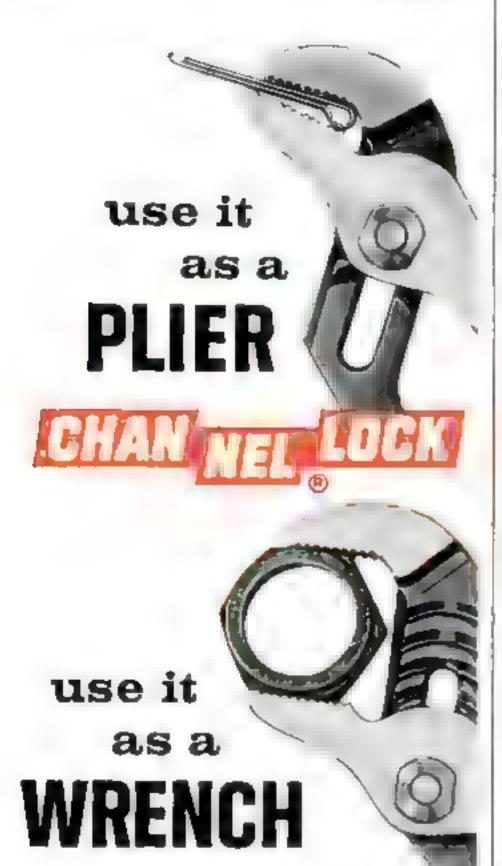


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Whispering bats. Some of the tropical bats are the quietest bats of all. They "whisper" ticks that are very complicated mixtures of sound. They've skinned the time for each to an even smaller fraction of a second than the FM bats.

And vampires. Most whispering bats have simple tastes in food—insects or fruit—but there is a more sinister branch of their clan: the vampire bats.

True to the family reputation for quietness, the vampire sneaks up on his sleeping victim, gently pricks the skin with his sharp teeth, then drinks the blood that flows before clotting.

While the study of such individual species of bats may leave you cold—if not shuddering—it does provide clues to one of the most intriguing puzzles of all: How do bats avoid being "jammed"?

Jamming. A bat faces two jamming problems. One is the noise of nature itself beating in on his eardrums. The other is discrimination: How does a bat know a raindrop from a gnat? How can he pick out the echoes from his flying edibles from strong echoes rebounding from trees, rocks, buildings—and, more annoyingly—other bats?

Scientists aren't sure. They do know that he possesses the skill to an extraordinary degree. Lab tests show that most bats can tune in the weak echo of an insect at a level of intensity between 1/1,000 and 1/10,000 that of the surrounding noise.

Push them to the limit, though, and bats can be jammed. Dr. Griffin and his colleagues found that artificial noise will confuse bats flying obstacle courses in the laboratory.

The scientists produced a harsh, loud, continuous noise. The bats ignored it in favor of their special ultrasonic frequencies. (Much human noise apparently is inaudible to bats.)

Then a rhythmic pulse—to compete with bat rhythms—was tried. The bats weren't in the least perturbed—presum-

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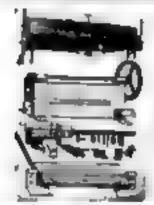
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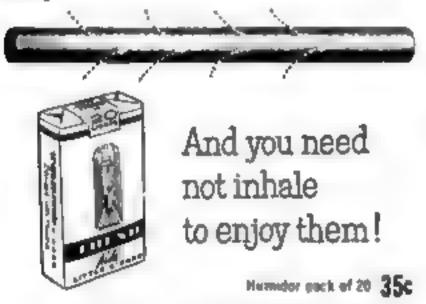
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The Weird and Wonderful Bat

ably they heard their own echoes in between.

A loud hissing noise that spanned the whole vocal range of bats had some effect. But smart bats could dodge wires with the same uncanny accuracy as they had before the noise was added.

The crucial test was not how much noise was introduced, but how large the object to be detected. Only when the obstacle wires were reduced to half their size and the loud hissing noise focused into the bat's path did the bat fail to dodge the wires.

The Doppler effect. Bats' antijamming equipment probably involves hypersensitivity to their own patterns of sound as well as an ability to close their ears to unwanted sounds. But individual species may have their own special aids.

The horseshoe but with his one-note signal may get a boost from the Doppler effect—that's the change in pitch that results when a sound source is moving. If the but is moving in on an object the echo will come back with a higher pitch. The reverse happens if he's moving away.

FM bats on the other hand, would have a hard time noting any slight change in pitch. Scientists think the very distinctiveness of their chirp echoes singles them out from just any old sound in the background.

FM bats may have another point in their favor. Tests show that high-level brain activity in mammals is stimulated more by mixed sounds than monotones.

Psychological cues probably help bats, too. Just as we have little difficulty understanding English when it's mumbled at us but have great difficulty making sense out of foreign tongues, bats may have the same ability to read mosquito echoes amidst "foreign noise."

There are lots of other things scientists would like to know about bats. Can they really "see" with their ears? Do they recognize a landscape? Can they tell size, shape, perhaps something akin to color? The answers to these questions, besides stripping the mystery from a spooky animal that has fascinated men for ages, should be very useful to the designers of radar and sonar equipment. They might lead to a black-box "seeing-eye" for blind people. Or to a warning device to prevent automobile collisions.

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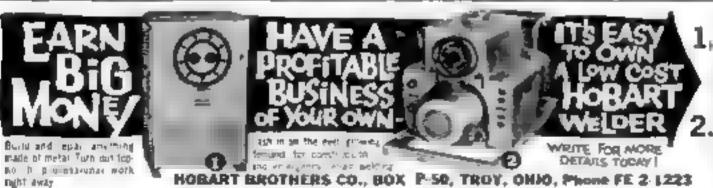
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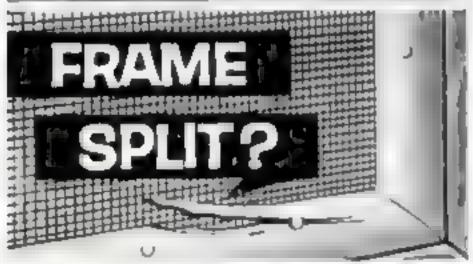
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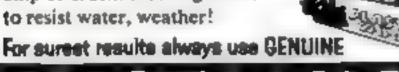
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Silent Engine Starts with a Match

[Continued from page 113]

Smaller than a shoe box. What pressurization does was demonstrated for me at the Allison Division of General Motors, which is developing the engine as a solar power plant, Harvey Welsh, Chief of Advanced Projects, connected a gas hose to a model smaller than a shoe box. Thirty seconds after it was lit, he flipped the shaft over. Immediately the engine began to run at about 2,000 r.p.m. Operating on air at atmospheric pressure, it drove a small generator to power a radio.

Presently Welsh turned off the gas. The engine kept running on heat stored in its walls and regenerator. Then Welsh gave a small air pump in the base a few strokes. At once the speed of the engine jumped to almost 3,000 r.p.m.-with no flame under it.

The displacer has to move about a quarter of a revolution ahead of the power piston. The ingenious rhombic drive that does this has two shafts geared together, four con rods, and two crossheads.

It has several advantages despite its Rube Goldberg appearance. It eliminates side forces on the piston rods, making it easy to achieve gas-tight gland seals. With only a straight rod emerging from the cylinder, the crankcase is easily sealed off from it and need not be pressurized. Instead, a small buffer chamber below the power piston is kept at working pressure

But most important, this radical drive makes a perfectly balanced one-lung engine possible for the first time. By making the masses of the two pistons and their rods equal, all inertial forces can be exactly balanced with counterweights opposite the crankpins.

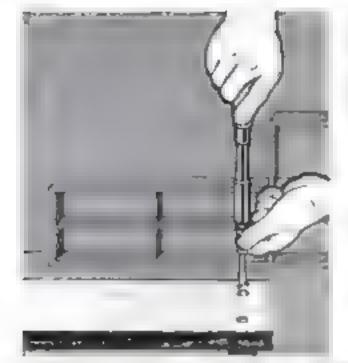
40 hp. with hydrogen. A whopper of a one-lunger is developing 40 hp. at the General Motors Research Laboratories in Warren, Mich. "When you put your hand on it," says Welsh, "you can hardly feel that it's running. It's the smoothest reciprocating engine I've ever known."

With hydrogen as its working fluid, that engine attains an efficiency of 39 percent, develops its 40 hp. with a piston displacement of 20 cu. in.

Licensed under Philips patents, General Motors first turned over development work to its research laboratories. Dr.

748 POPULAR SCIENCE MAY 1960

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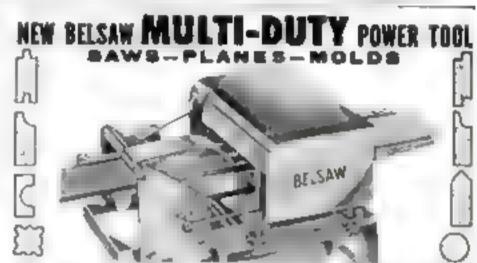
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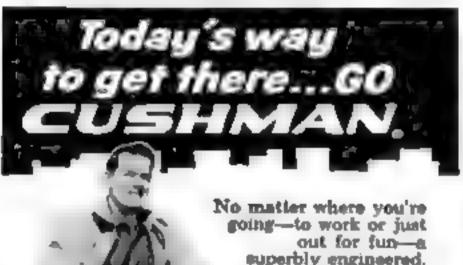
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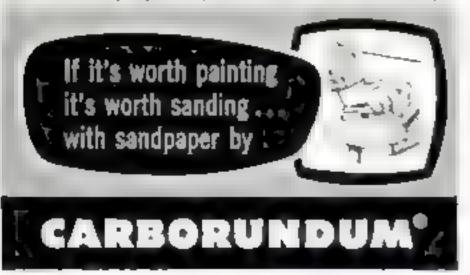


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Silent Engine Starts with a Match

Charles Russell of that division first discussed the use of the Stirling engine as a satellite power plant three years ago. This project was turned over to the Allison Division under Tibor F. Nagey, Director of Research, and Harvey Welsh, section chief.

The rhombic drive is ideal for a satellite plant because of its freedom from vibration and the canceling out of all gyroscopic action (which would make the satellite cartwheel in space). Heat will be supplied by the circulation of lithium hydride, a metallic compound that melts at 1,256 degrees, from a heat-absorbing reservoir at the focus of a solar mirror or lens.

With no air to cool the fins or a circulated cooling fluid, keeping the cold space of the engine cold is more of a problem than heating. The only way to get rid of heat in airless space is by radiation. This requires a big radiating surface—218 square feet for the three-kilowatt system. Fluid coolant will dissipate its heat to this, and the surface will radiate it away.

The engine will keep working while the satellite passes through the earth's shadow—35 pounds of lithium hydride can store as much energy, in the form of heat, as 1,100 pounds of batteries.

The engine itself accounts for only 6.7 percent of the 415 pounds that is the total weight of the system. But this is lighter than any equivalent direct-conversion system. Enough silicon solar cells to yield three kilowatts, for instance, weigh 600 pounds.

Designed to run despite damage from micrometeorites, the Stirling solar power plant is expected to go for two years at least. It won't use hydrogen (a gas that eventually seeps even through steel), but slightly less efficient helium. And just to make sure the helium doesn't get away, the engine and generating unit will be packaged in one hermetically sealed case.

That silent outboard? It will be along, Welsh believes, in three or four years. Lawn mowers and other applications will come when it is possible to make the engine cheap enough to compete with the gas one-lunger. Or, perhaps, when you're willing to pay extra to let your neighbors sleep while you mow the lawn.

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Your Best Defenses Against Burglary [Continued from page 122]

awakened the occupants to make them produce more valuables. "Anybody pulling a trick like that," an old-time crook told me, "is either junked up or crazy—maybe both. He's asking for trouble. That guy is a lead-pipe cinch to wind up killing somebody."

Such cases are rare, but if you find yourself a victim, follow three simple rules: 1) be as calm as you can; 2) comply with every demand, giving up your cash and valuables; 3) get as good a description of the man as you can.

The "muscle-provel"

Gaining in criminal popularity is forcible entry by trickery. The criminal is a cross between a holdup man and burglar, and may specialize in preying on housewives during daylight hours.

Muscle-prowlers often work in pairs. They generally ring the bell and claim they are from the telephone or electric company. They are usually dressed in coveralls, carry tools, and may flash some identification. Once inside, the housewife learns their true mission when she looks into a gun or feels the point of a knife at her throat. On threat of death, rape, or mutilation, she is forced to provide valuables. If she is cooperative and doesn't scream, she may be left unharmed. though gagged and bound. If she becomes hysterical, her life is in danger. These punks are generally drug addicts, and may respond to panic with panic.

A door chain or peephole is a basic protection against this kind of entry. When summoned to the door, your wife should open it with the chain in position. If a man says he is from a utility company, she should make him show his company credentials. If there is any doubt in her mind, she should let him wait outside while she calls the company to verify his mission.

Another trick of muscle-prowlers is to carry a large package. If a woman opens the door to accept it, entrance may be forced before she realizes what has happened.

Where there is doubt, she should tell them to leave the package outside and bring it in only after she has watched them leave. Or she might tell them to wait until she's telephoned the store. Im-

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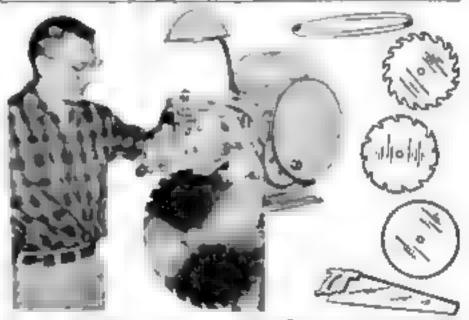


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Another impersonation is of the doorto-door salesman. Tell your wife to talk to unsolicited salesmen only through the eyehole in the door or with the door chained. If she must leave momentarily while someone is still there, she should close the door and make him wait outside. Reason: A crook left alone at an open (although chained) door, can remove the cylinder anchor screw of the lock, or plug the strike hole in the door

jamb, for entrance later.

There are other precautions to help prevent intrusion. When you are out for the evening, leave a light burning in at least one room. (But don't do this if you're to be away some days; the sameness may tip off a prowler.) A dog is a natural nemesis of burglars; regardless of how small he is, his bark is likely to frighten away burglars. In isolated areas, put lights around the grounds. A home off by itself is a natural target for prowlers, but if they must cross or work in a lighted area, they prefer to leave that house alone.

If you plan a prolonged absence from your home, notify the police of your departure date and estimated time of return. They will keep watch, and investigate any signs of movement or lights in what they know to be an unoccupied home. Cancel deliveries of newspapers and milk while away, and arrange with a neighbor to accept your mail and take an occasional look at your home. If you plan to be gone for weeks, arrange for someone to cut the grass. Unattended lawns are one of the signs burglars look for.

Make a record of all serial numbers on cameras, guns, typewriters, and binoculars. This can help recovery, and aid in making insurance claims. If you should be confronted by a burglar, obey his orders, but get as good a description as possible. Remember what he has touched, where he stood, and any peculiarities in speech and mannerism.

Finally, remember that even if a burglary loss is uninsured, material losses can always be replaced. If you expose yourself to the risk of serious, perhaps fatal, harm, all the valuables in the world are of no importance.

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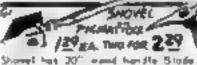
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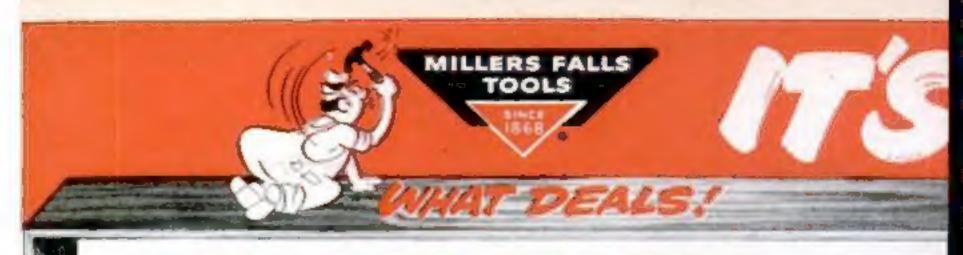
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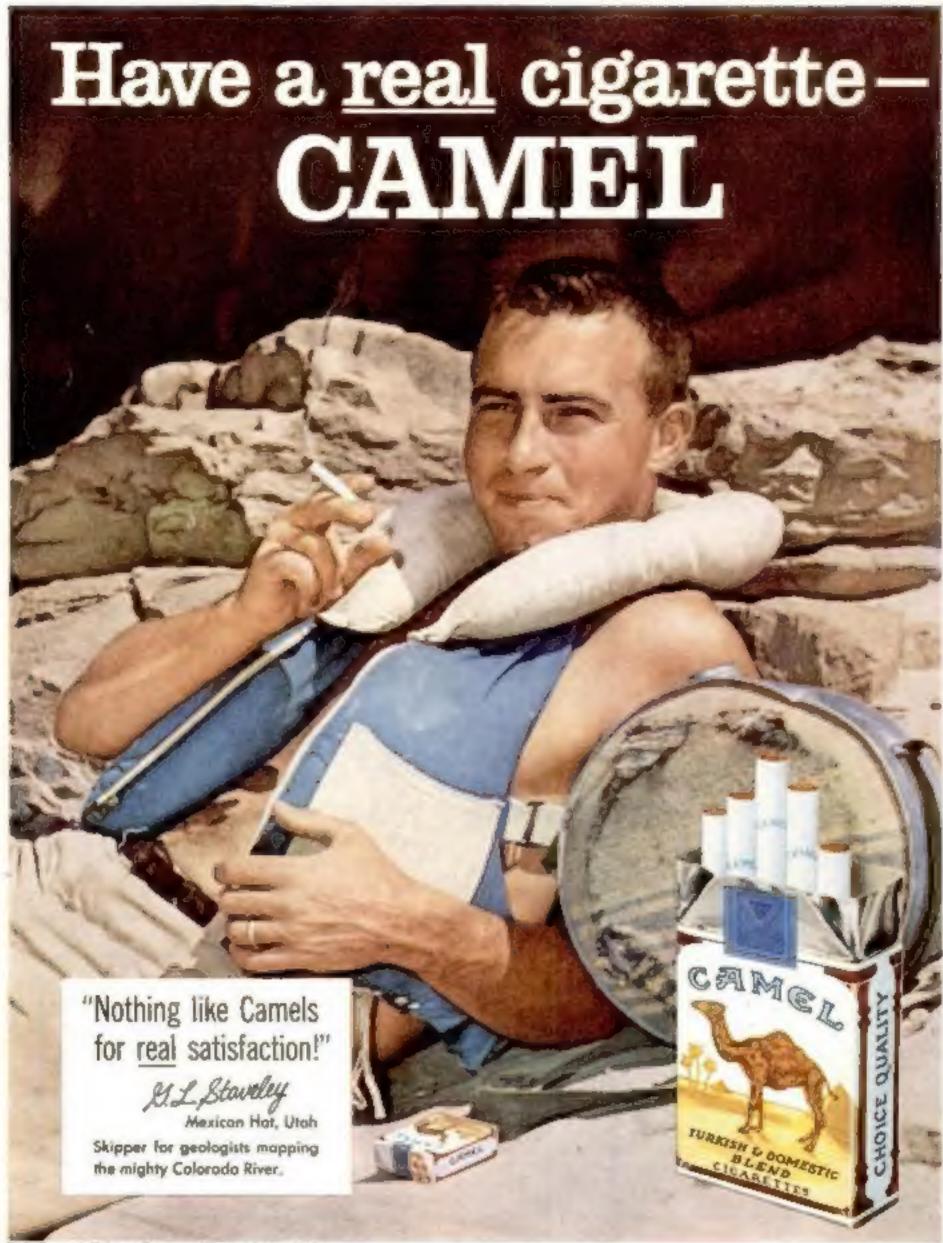


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